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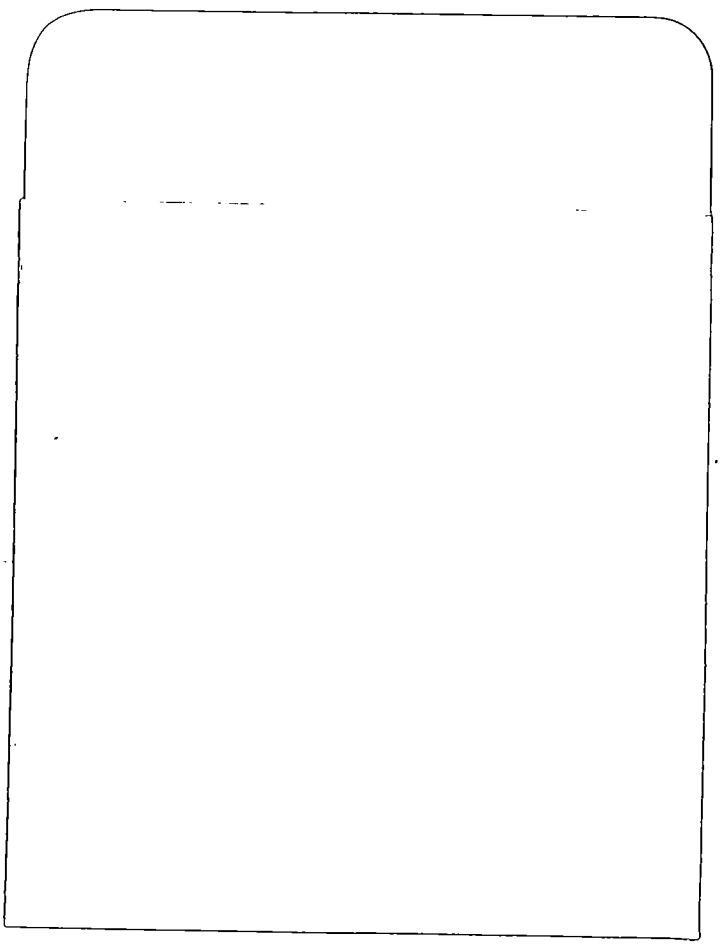
FM 31-71

DEPARTMENT OF THE ARMY FIELD MANUAL

NORTHERN OPERATIONS

HEADQUARTERS, DEPARTMENT OF THE ARMY

JANUARY 1963



FIELD MANUAL
No. 31-71

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C., *10 January 1963*

NORTHERN OPERATIONS

			Paragraphs	Page
CHAPTER 1.	GENERAL			
Section I.		Introduction	1–7	3
II.		Effects of environment on military operations	8, 9	7
CHAPTER 2.	OPERATIONS			
Section I.		Planning	10–13	10
II.		Organization	14, 15	13
III.		Mobility	16–20	16
IV.		Intelligence, patrolling, counterintelligence, and security	21–23	21
V.		Offensive operations	24–33	25
VI.		Defensive operations	34–37	30
VII.		Retrograde movements	38, 39	32
VIII.		Special operations	40–44	33
IX.		Joint operations	45–49	39
CHAPTER 3.	COMBAT SERVICE SUPPORT			
Section I.		General	50–52	48
II.		Planning	53–57	48
III.		Organization for logistic support	58–62	55
IV.		Materiel and services	63–66	60
V.		Medical evacuation and hospitalization	67–69	64
VI.		Traffic control	70	65
VII.		Personnel	71–77	66
CHAPTER 4.	EMPLOYMENT OF ARMS AND SERVICES			
Section I.		Infantry	78–84	69
II.		Armor units	85–95	72
III.		Artillery	96–104	79
IV.		Army aviation	105–112	86
V.		Chemical, biological, and radiological operations	113–118	91
VI.		Nuclear weapons	119–122	99
VII.		Engineers	123–132	100
VIII.		Medical service	133, 134	118
IX.		Ordnance	135–138	119
X.		Quartermaster	139, 140	121
XI.		Signal	141	124
XII.		Transportation	142–146	125

*This manual supersedes FM 31-71, 6 January 1959.

		Paragraphs	Page
CHAPTER 5.	SIGNAL COMMUNICATIONS		
Section I.	General	147–149	127
II.	Radio communication	150–157	128
III.	Wire communication	158–161	133
IV.	Visual communication	162–164	136
V.	Messenger	165–167	137
VI.	Photography	168, 169	138
VII.	Maintenance and care of equipment	170–178	138
CHAPTER 6.	TRAINING		
Section I.	General	179–183	142
II.	Winter training	184–189	143
III.	Training — Other Seasons	190	146
IV.	Hints for instructors	191–193	146
APPENDIX I.	REFERENCES		149
II.	SUGGESTED TRAINING PROGRAM FOR WINTER INDOCTRINATION		152
III.	COMMANDERS' GUIDE LINES FOR NORTHERN OPERATIONS		181
GLOSSARY			185
INDEX			188

CHAPTER 1

GENERAL

Section I. INTRODUCTION

1. Purpose and Scope

a. This manual provides doctrinal guidance to commanders and staffs for operation and administration of combat units in the northern regions of the world under conditions of either nuclear or nonnuclear warfare. This manual indicates that cold, with its attendant unpleasantness and complicated living conditions, affects military operations but does not prevent them. The material contained in this manual is directed primarily toward operations below division level. Operations at division level and above will be essentially the same as those in other areas of the world. It is the forward elements of divisions or task forces that must overcome the many problems inherent in northern operations. Commanders and staff officers at all levels must understand and appreciate the effects of the northern environment on the operations of these forward units and carefully consider them when planning each operation. The reader should refer to FM 31–70 and FM 31–72 and to other manuals of the arms and services for further information concerning northern operations (app. I).

b. Users of this manual are encouraged to submit recommended changes or comments to improve this manual. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons should be provided for each comment to ensure understanding and complete evaluation. Comments should be forwarded direct to U. S. Army Cold Weather and Mountain School, Fort Greely, Alaska.

2. Area of Northern Operations

a. The area of northern operations (fig. 1), for purposes of this manual, is defined as the area in the Northern Hemisphere which lies north of the temperate zone where climatic conditions require the application of special techniques and equipment that are not normally required for operations in a more temperate climate. Included in both summer and winter operations are the considerations of mountain operations and inadequate land lines of communications.

b. The term Northern Operations, as applied to this manual, includes both the Arctic and Subarctic. About 45 percent of the North American continent and 65 percent of the Eurasian land mass lie in these regions.

c. The terms "cold weather operations," "operations in the Subarctic," "Arctic operations," "Northern operations," "operations in the far north," "cold region," and "operations in the northern latitudes" are synonymous. They embrace operations in both summer and winter and are applicable to the areas of North America and Eurasia.

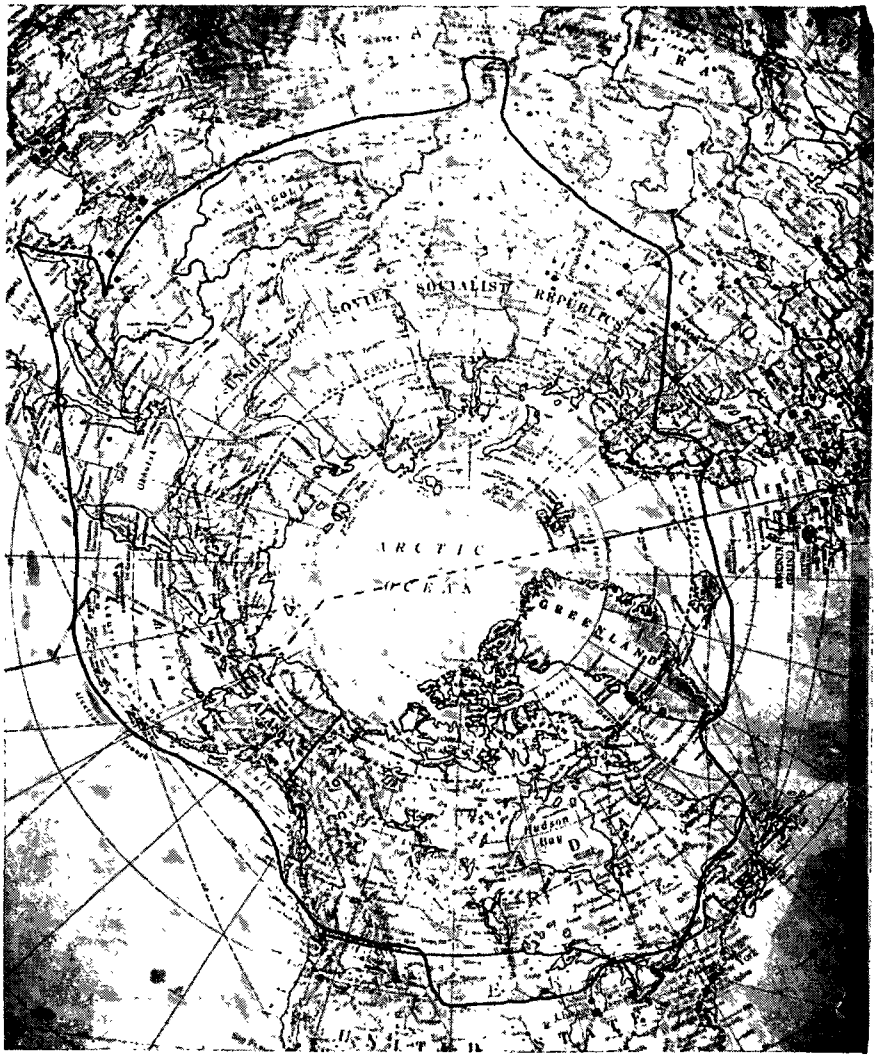


Figure 1. Area of northern operations.

3. Basic Considerations

a. The environment is a dynamic force. He who recognizes it and understands this force can use it; he who disregards or underestimates it is threatened with failure or destruction. Individuals must understand the effects of the environment and have the training, stamina, and will-power to take the proper actions. Because of the demanding requirements on the individual soldier, leadership must be of the highest caliber. Leaders at all levels, down to the squad, must make decisions far surpassing the scope of their usual responsibilities. In the north the human element is all-important. The effectiveness of equipment is greatly reduced. Specialized training and experience are essential. The climate does not allow a margin of error for the individual or the organization.

b. The mobility of all units is restricted. Movements must be carefully planned and executed with the knowledge that distance can be as difficult to overcome as the enemy. Momentum is difficult to achieve and quickly lost. All means of transportation must be used.

c. Because of the extremes of northern environment maintenance of equipment is of paramount importance.

4. Organization

With modifications, the current Army divisions are suited for operations in the north. The changes in personnel structure and equipment authorizations are the result of added emphasis on the following: mobility, maintenance, communications, and additional logistical support. Certain items of equipment are eliminated or added based on their suitability to the terrain and environment.

5. Command Leadership

Leadership is more demanding and important in the north than in most areas of the world. Emphasis is on small unit operations. Command is decentralized to insure maximum flexibility for leaders at all levels. Resourcefulness and initiative are requisites for unit commanders. *Forceful action is the key to success in the north.* Commanders at all echelons must plan and prepare their operations in great detail, actively supervise, keep themselves and their subordinates informed, and maintain close coordination with adjacent and supporting units.

6. Tactics

a. Tactical principles for operations in the north are the same as those employed in other areas.

b. Mobility is a cardinal principle of operations in the north. Mobility can only be obtained through proper integration and use of all available transportation, including aircraft, wheeled and tracked vehicles, water craft, and individual means.

c. Operational planning emphasizes the use of envelopments and occasionally turning movements to exploit the principle of surprise. The attack may be conducted as an envelopment to seize objectives from which the enemy position may be dominated by fire or from where he may be attacked from the rear.

d. Advance to contact is conducted under cover of a highly mobile force. The force should contain aviation, tanks, other combat and combat service support elements, and sufficient firepower to eliminate minor opposition.

e. During winter operations in the Far North, night movement and night attacks should become the rule rather than the exception. An attack has a better chance of succeeding during the night because slow moving columns of troops and equipment are easily located and are extremely vulnerable during daylight.

f. Lines of communications are the life blood of forces in the north. Enemy forces may be defeated by interposition of forces between the enemy base of supply and his forward elements.

g. Lack of adequate ground lines of communications requires more emphasis on the use of aircraft and low ground pressure cross-country vehicles for supply, resupply, and troop movements.

h. Deception is vital in all operations because of the vulnerability of forces in the north brought on by problems of concealment, slow movement of troops, and limited land lines of communications.

7. Logistics

a. The unusual weather and terrain conditions that are found in northern areas make problems of supply, evacuation, transportation, and services more difficult and more time consuming. Time and space factors vary with the terrain, the climate, and the season. More time must be allowed for movement of supplies and troops because of the environment. Distance is measured in time rather than space.

b. Commanders must issue their orders early to allow adequate time for subordinates to move supplies and equipment. Logistical support planning is required in great detail, even for small unit operations. Adequate support must be provided to troops to ensure survival and comfort as well as combat resupply. Plans should include considerations for food, fuel, clothing, sleeping gear, tentage, mountain gear, winter equipment, repair parts,

and ammunition or nuclear weapons, as appropriate. All means of transportation, to include aircraft, water craft, wheeled and tracked vehicles, and individual means, must be considered in movement of supplies and equipment.

c. Exchange of individual and organizational winter equipment such as skis, cargo sleds, wanigans, snow removal equipment, and many others for summer gear in the spring and vice versa in the fall, presents a major logistical problem, particularly at the division and higher levels. To guarantee an uninterrupted operation, careful planning including a schedule for gradual exchange and shipment or storage of the equipment as dictated by the tactical situation and seasonal transition is mandatory.

Section II. EFFECTS OF ENVIRONMENT ON MILITARY OPERATIONS

8. General

In northern latitudes, the conduct of military operations is circumscribed by considerations foreign to more temperate regions. The long hours of daylight and the heat and dust of summer (fig. 2), the long nights and the bitter cold and storms of winter, the mud and morass of the transition periods of spring and autumn, the disrupting effects of natural phenomena, the scarcity of roads and railroads, the vast distances and isolation, and occasionally the lack of maps combine to affect adversely but not totally restrict mobility, firepower, and communications. In spite of adverse conditions, operations are feasible through employment of aggressive leadership, a high state of training, and adequate logistical support.

9. Operating Conditions

a. The most suitable time for operation is from midwinter to early spring before the breakup period. The snow is "settled," giving well-trained troops an excellent opportunity for oversnow mobility. During this period, operations are possible even in a roadless wilderness. Early winter, after the formation of ice, is also favorable; however, it does not afford well-trained troops the same oversnow and cross-country mobility as midwinter. The winter cold requires the use of special cold-weather clothing and equipment and places a premium on fuel for warmth. Tracks in the snow and ice fog, created by a heat source, complicate the camouflage of positions. The high winds and phenomenon of whiteout can interfere with aviation operations. High winds can also combine with the cold to make moderately cold weather

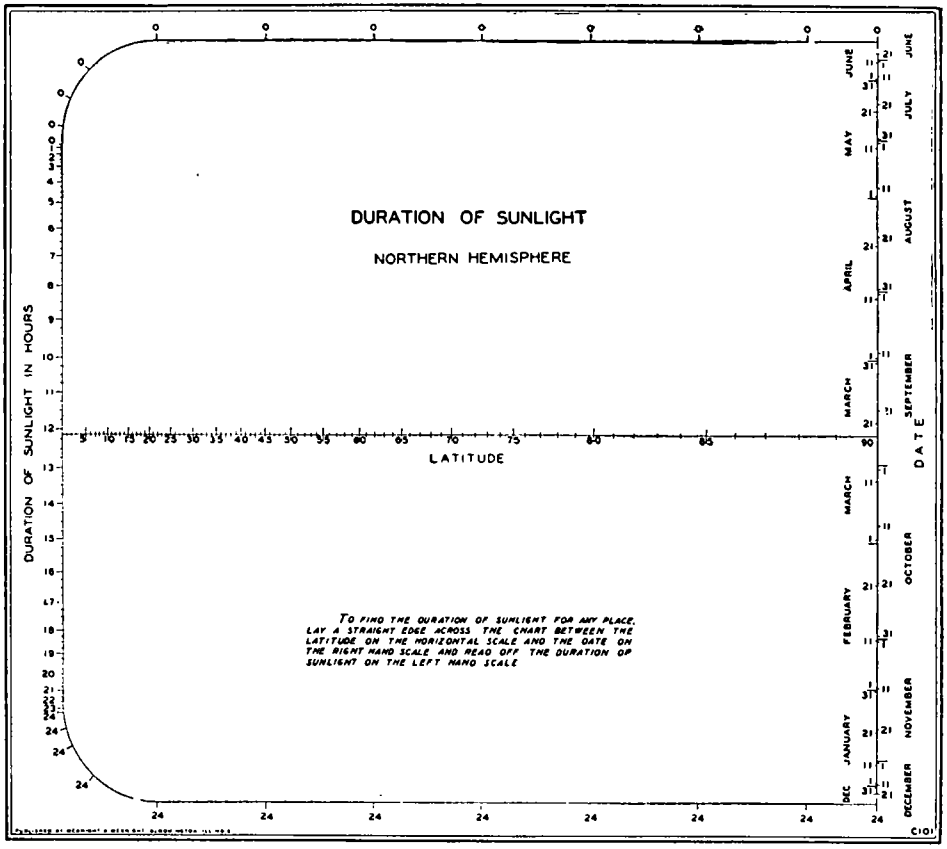


Figure 2. Hours of daylight in northern regions.

extremely uncomfortable. In midwinter, the environmental factors — extreme cold and deep snow — may be used to advantage by leaders with initiative and ingenuity.

b. Limited objective operations are feasible in spring if timed for the period when daytime thaw and nighttime freeze leave only a thin layer of mud on deeply frozen ground, and lake and stream ice is still firm. However, these operations may be interrupted by a sudden breakup period, causing them either to slow down or stop entirely.

c. At the end of the breakup season, operations can be resumed after the ground has dried sufficiently to allow traffic-ability. Men and vehicles, to some degree, regain mobility. When operating in the low areas, the numerous streams and swamps will require greatly increased engineer effort and the use of special equipment. The many rivers and streams can often be used for the movement of troops and supplies.

d. In autumn, poor drainage may cause low-lying country to become isolated from the surrounding terrain. Roads may become flooded. Poorly constructed roads disintegrate. Often, the only means of transportation is by aircraft and low-ground-pressure vehicles. Attempts to maintain normal ground mobility are very exhausting to troops and hard on equipment.

CHAPTER 2

OPERATIONS

Section I. PLANNING

10. Concept

a. Extended areas of responsibility, reduction in troop density, and battle area isolation, plus difficulties in communication and control, require the use of mission type orders that give maximum latitude to subordinate commanders. Northern operations require that tactical commanders be given every possible opportunity to exploit local situations and take the initiative when the opportunity is presented.

b. Low troop density, extended deployment, and difficult logistics emphasize economy of force in northern operations. Because of this economy of force and the high proportional logistical tonnages associated with northern operations, troop density is of necessity small and overhead elements reduced to a minimum. In addition, economy of force requires maximum use of cover and deception capabilities, rapid movement, camouflage, concealment, and operations under darkness or adverse weather conditions.

c. Planning of any scope must emphasize the logistical impact of any tactical scheme on the overall support problem. The lack of roads and shelter, plus climatic severity and other environmental difficulties, require that logistical plans be flexible and adaptable enough to permit adjustment of supply means without endangering the overall effort. Restrictions imposed by extremes of climate and terrain constitute the major change from operations in temperate areas. These restrictions may, unless proper provisions are made, constitute major obstacles to the successful conduct of the operation. Mobility is a prerequisite to success. It can be achieved only through careful planning, training, and the use of specialized equipment.

11. Special Factors

The following special factors will influence operational planning:

a. Low Population Density. Settlements, supplies, quartering facilities, and lines of communication are limited. Their control or destruction becomes of major importance.

b. Roads and Railroads. Roads and railroads may be limited and those that do exist are usually vulnerable to enemy action. In addition, climatic conditions may greatly affect their use.

c. Lakes and Waterways. Lakes and waterways are prevalent and may either aid or hinder the operation depending upon climatic conditions. With sufficient ice thickness, they are easily crossed and may be used as natural routes of communication or airstrips. In some instances, drifted and hard packed snow makes landing on ice difficult, requiring further preparation of the airstrip. In the summer, waterways may either be major barriers or lines of communications. Many of the streams are glacier-fed and carry great volumes of water in the summer. Careful reconnaissance is required as the location of their main channel often changes from year to year.

d. Mapping. Occasionally, maps may be unreliable or even nonexistent. Therefore, requirement for timely aerial photography may be increased as a source of terrain information.

e. Navigation. Difficulty of land navigation is increased by lack of landmarks, large forested areas, periods of reduced visibility, difficulty of cross-country movement, and by large magnetic declinations in areas adjacent to the magnetic pole.

f. Weather. Weather is an important factor to be considered in the estimate of the situation and may dictate a course of action. As an example, the attacker or defender in a snow storm with the wind at his back has a marked advantage.

g. Whiteout. At times, overcast sky and snowcovered terrain create a condition of visibility which makes recognition of irregularities in terrain very difficult.

h. Forested Areas. Forested areas offer concealment and present excellent opportunities for ambushes and hit-and-run tactics. They provide comparatively good protection against wind and snow storms but present a serious obstacle to cross-country mobility. In the summer, forests burn easily, and fires may become a major problem. Units in forested areas are highly vulnerable to the blast effect from nuclear weapons.

i. Snow Cover. Snow enhances the movement of troops suitably equipped and trained, but reduces the mobility of troops lacking proper equipment and training.

j. Ice Cover. Freezing of rivers, lakes, and swamps aids movement and operations.

k. Extreme Cold. The effects of cold must be considered; however, the proper use of clothing and equipment will largely overcome any difficulties.

l. Sudden Changes in Weather. These changes include extreme temperature changes, snow storms, strong winds, and dense fog. Changes may be sudden and must be provided for. Every advantage must be taken of favorable conditions of even short duration.

m. Daylight and Darkness. The long night of the winter must not be considered a bar to operations. For example, movement, camp building and breaking, scouting, and patrolling must be considered normal night activities The proper utilization of the available daylight hours assumes major importance in planning.

n. Ice Fog. The phenomenon of ice-particle fogs is a very common occurrence around inhabited areas during cold winter weather. They are found much of the time when temperatures drop below —20° F. Their origin — in marked contrast to that of ordinary super-cooled fogs — lies in the copious local production of water vapor by human activities, coupled with an inability of the stagnant air at such low temperatures to hold the water vapor. Such sources of water vapor may include the exhaust from vehicles and aircraft, the vents of steam from permanent type heating systems, the air ventilated from humid rooms, and the stove pipe effluent from space heaters. In the field, such a fog may appear over a body of troops, a herd of animals, bivouac areas, motor parks, airfields, convoys, and gun positions when firing. Ice fog obscures the gunner's vision along the line of fire and may disclose the location of weapons, vehicles, and troops.

o. Seasonal Transition. The periods of seasonal transition must be carefully considered. Climatic changes become more abrupt and the appearance of terrain features changes rapidly. A frozen river may one day present little problem and the next day be a major obstacle.

p. Atmospheric Disturbances. Extended operating distances and atmospheric disturbances make military communications difficult.

q. Delayed Personnel Responses. The extreme environmental problems encountered by personnel require that delay and time lag be considered in all planning.

12. Fire Support

Fire support planning for northern operations is basically no different than that required for more temperate regions. How-

ever, limited artillery mobility increases the requirement for tactical air support.

13. Additional Considerations

a. Lack of large population densities and industrial complexes in the north have direct impact on unconventional warfare activities. Low subsistence levels, lack of shelter, and primitive communications also are of importance in planning the supply of unconventional warfare operational areas. The impact of terrain, extreme weather conditions, and extended periods of darkness on the logistical operations of regular forces is highly favorable to guerrilla operations. Extended lines of communication, restricted to ground movement over few routes, are highly vulnerable to such operations. Guerrilla warfare, carried out under these conditions could be a decisive factor in northern areas.

b. Psychological Warfare opportunities inherent in the environmental extremes, isolation, and personal discomfort present in northern operations are exploitable. Winterization of loudspeaker equipment and presses is a requirement. Low troop density, difficulty in positive identifications, and relatively limited movement of troops in tactical localities make accuracy in leaflet dissemination and radio broadcasting critical. Enemy psychological warfare operations may be expected to utilize all available propaganda media (radio, printed matter, loudspeaker, rumor, etc.) to emphasize discomfitures due to the cold environment in attempting to reduce the morale of our forces.

c. Low population density and lack of communications may reduce the refugee movement. The economic or political motivation prompting enemy settlement and defense of the area constitute comparable bases for U.S. interest and exploitation of area assets.

Section II. ORGANIZATION

14. Forces

In northern operations, the closely integrated combined arms task force is the basic building block. These task forces as an optimum are highly mobile, including army aviation, and a high proportion of combat engineer and signal units, and are supported logistically by a mobile direct support element. The task forces must be capable of conducting independent operations at extended distances from higher headquarters, adjacent units, and logistical bases. Figure 3 shows the organization of a type company-sized task force; figure 4 shows a type battalion-sized task force; and figure 5 shows a type brigade.

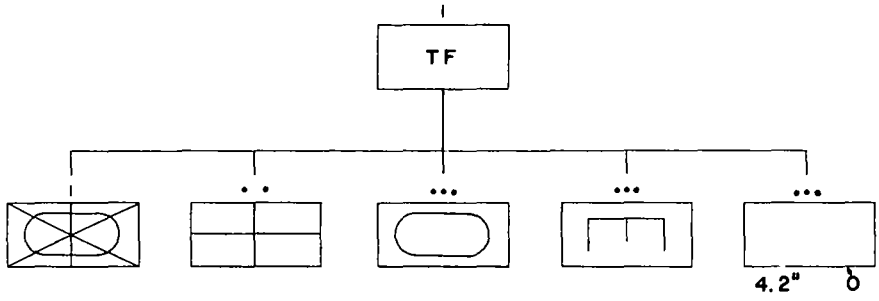


Figure 3. A type company task force.

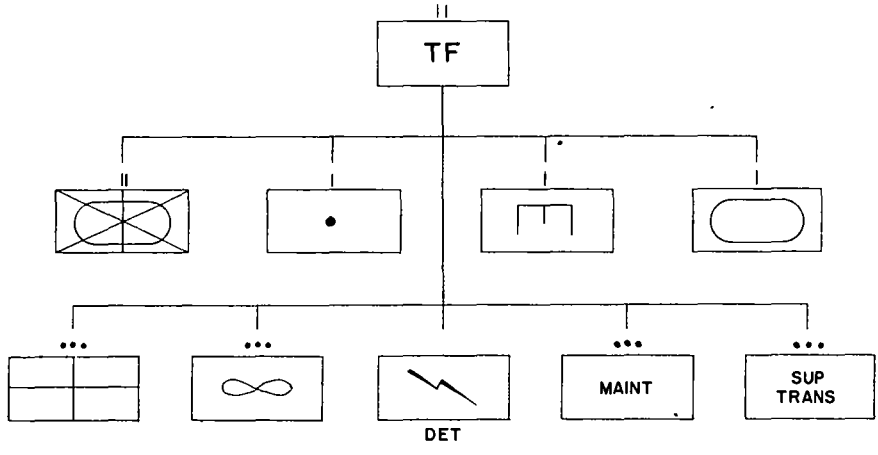


Figure 4. A Type Battalion Task Force.

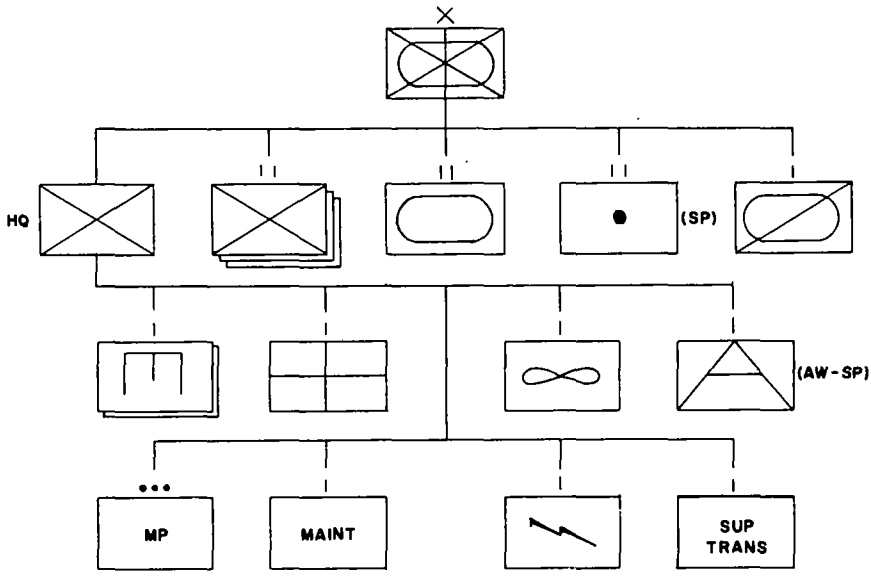


Figure 5. A Type Brigade.

15. Command and Control

a. Mission type orders are the rule. The need for immediate capitalization on any advantage generated by the enemy, terrain, or weather combined with communication difficulties demand that maximum authority and initiative be exercised by task force commanders and their subordinates.

b. When possible, command posts and control facilities are mechanized. Vehicles and shelters require either self-contained or associated heating and lighting.

c. The use of highly mobile signal equipment with a cross-country capability is an absolute requirement for the task force in northern operations. Relay capabilities are frequently required both within the task force and between the task force and higher headquarters.

d. Reduced ground visibility, lack of navigational aids, and extended distance require the use of army aviation as a means of command reconnaissance, liaison, and communications relay.

Section III. MOBILITY

16. General

a. Ground mobility is effected by inadequate transportation nets. During the winter, low temperatures, snow and ice, and the difficulties of constructing roads and trails hinders movement. During the breakup season, ice is weakened on lakes and streams, and existing roads become almost impassable. Extensive overland movement is difficult during the summer because the underlying permafrost prevents effective drainage and extensive swampy areas result.

b. Movement with army aircraft equipped with conventional landing gear, skis, amphibious landing gear, or flotation kits offers an effective means of mobility in the undeveloped regions of the north.

17. Effects of Climate

a. Winter Conditions.

(1) Snow affects mobility of ground troops in a number of ways. Heavy snow cover by itself impedes movement, either cross-country or on roads. Snow cover also blankets many terrain features, hiding obstacles to movement such as stumps, rocks, ditches, small streams, fallen trees, and mine fields and other man-made obstacles. Snow cover acts as a thermal insulator which retards the freezing or thawing of underlying ground. When snow melts, it saturates the ground and often makes it impassable. Snow or ice on roads, under certain conditions, makes driving difficult and dangerous. On roads and airfields, snow increases maintenance requirements since it requires removal or compaction. Traction on compacted snow is generally better during extremely cold weather.

(2) Conventional wheeled vehicles or men on foot cannot travel satisfactorily over flat terrain or roads when the depth of uncompacted snow exceeds 30 cm in depth. Most tracked vehicles are slowed by a snow depth of 60 to 75 cm. Specialized giant wheeled vehicles with oversized tires and low-ground-pressure tracked vehicles can generally operate effectively in deep snow (fig. 6). However, snow of more than 75 cm depth, especially when granular or powdery, can stop movement except special oversnow vehicles.

(3) As a general rule, units that normally move on foot should be equipped with skis rather than snowshoes. The sliding characteristics of skis assure a greater mobility potential. Troops mounted on skis can be towed behind vehicles (skijoring). Snowshoes are suitable for personnel in the field trains, mortar and artillery crewmen, mess personnel, drivers, mechanics, tank crewmen, and other personnel with similar type duties. Elements of supporting units moving with rifle companies, such as forward observers, medicos, and engineers, must also be equipped with skis. Combining of fast moving rifle elements on skis with slower moving troops on snowshoes should be avoided. A number of snowshoes and skis may be carried by the unit supply of each rifle company to be issued for special tasks.

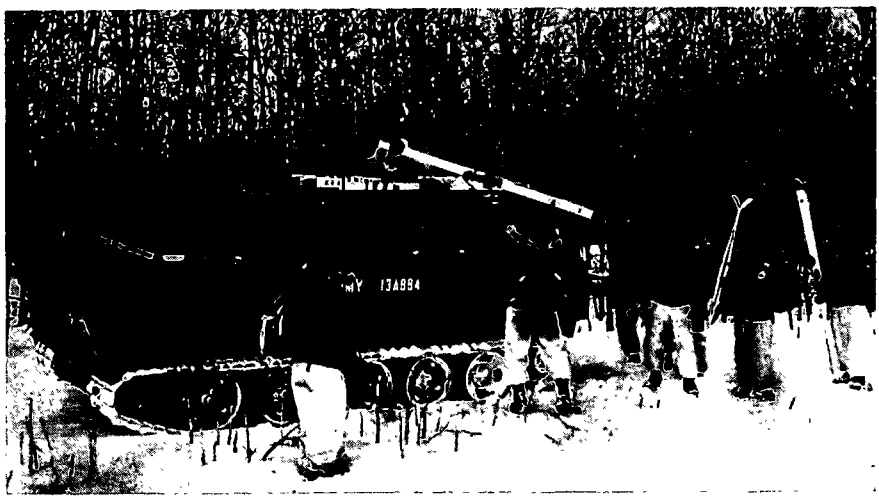


Figure 6. Oversnow mobility.

b. Summer Conditions. The northern regions in summer are characterized by an abundance of open lakes, streams, and swamps which tend to impede movement. Waterways may be used for military movement if equipment or improvised rafts are available. With detailed reconnaissance, braided streams, creeks, and graveled river beds may be used as routes for tracked vehicles through muskeg areas.

Figure 7. The effect of spring breakup on winter roads.

c. Seasonal Changes.

(1) During the spring breakup when rivers begin to thaw, the surrounding country may be flooded and impassable. The breakup is characterized by large ice jams. During this period vehicles should carry reduced loads (fig. 7). Traffic should be permitted only at night when temperatures are below freezing. This will allow engineers to perform necessary maintenance without interruption during the day. When nights become so warm that the roads will no longer freeze, heavy traffic may turn unpaved roads into morasses. At times all movement on roads may be stopped because of deep mud.

(2) In some areas of the north, fall rains complicate military movements. Unpaved roads are thawed during the summer, and the fall rains create deep mud. Ruts made in the mud during the day will freeze on cold nights and make movement with vehicles difficult. Frozen ruts tear tires and break wheels and axles. Vehicles may break

through the thinly frozen crust and may bog down. Under these conditions, vehicles should not overlap the tracks of the preceding vehicle.

(3) As the freezeup progresses and the ground becomes firm enough for tanks and other vehicles, cross-country movement is facilitated. However, great care must be exercised when tanks and heavy equipment, such as bulldozers, are being used on streams, lakes, or muskeg. These heavy vehicles may break through thinly frozen ice or ground and sink deeply into the mud or water. Once vehicles become mired, recovery is extremely difficult and time-consuming.

(4) Another hazard to cross-country movement is ground water springs, especially when covered with snow. Many of these springs do not freeze and cause some streams to have little or no ice and some lakes to have only thin ice. Their presence in muskeg areas can cause weak spots in otherwise trafficable terrain.

18. Terrain

a. The varying types of terrain present different problems. In forested areas, close tree spacing, fallen trees, rocky hummocks, boulders, bogs, rivers, lakes, and swamps present obstacles to summer movement. At times, deep snow cover in forested areas becomes an obstacle to movement.

b. Nonforested areas include the tundra, ice caps, grassland, semideserts, and the mountains above timberline. Each of the nonforested areas is distinctive in appearance and seasonal characteristics. They affect military operations differently. During summer, large areas of tundra resemble great plains. It is covered with a thick layer of hummocky moss interspersed with extensive marshes similar to those of temperate areas but usually not so deep because of the high permafrost table. The depth to the permafrost level will usually vary from 15 to 60 cm. Tundra soils are extremely moist. Cross-country tracked vehicular traffic is possible; soft, waterlogged soils, however, afford little or no wheel traction. Trafficability of the frozen tundra surface with its light snow mantle is much better in winter than in any other season.

c. The most serious problem to movement over glaciers and ice cap areas is crevasses. Special crevass detection equipment is available and should be used when traversing glaciated and ice cap areas. Trails should be selected and marked by the trailbreaking party when moving over any area that may contain crevasses. With the coming of low temperatures in winter, ice cap surfaces

become hard and wind swept. Newly fallen snow is blow into snow ridges which may be obstacles to movement. Wind blown compacted snow may become so hard that it will support troops on foot. Mechanized transportation is possible on this surface if snow ridges do not interfere. In many places, light ski-equipped aircraft may land and take off with safety.

19. Vehicular Mobility

Selection and preparation of a route for vehicular movement in the area of northern operations require special techniques.

a. A thorough map and terrain analysis is required to determine a number of possible routes through an area. The line of least resistance is followed to take advantage of natural cover, to gain concealment from air observation, and to avoid steep slopes, abrupt ravines, unfrozen swamps, open streams, and other obstacles. In winter, low terrain usually provides the best routes; in summer, normally, routes should follow ridgelines where solid ground is to be found.

b. Suspected trouble spots on routes selected by map study and/or aerial reconnaissance are then checked by a helicopter-borne or foot reconnaissance team. If possible, the helicopter-borne party must land and select a route over the most difficult terrain obstacles by ground reconnaissance. In selecting routes through heavily forested areas, a reconnaissance is made for lanes which may be widened. Edges of forests are often suitable. Routes in forests should be selected where trees are widely spaced and, if possible, in sandy soil. This will make it easier for heavy equipment to break trail and clear trees.

c. The advance guard of the column is provided the recommended route to be used by a helicopter-supported reconnaissance team. The advance guard then moves, breaking a route usually satisfactory for heavier tracked vehicles. Vehicles that may be used to break trail are bulldozers, tanks, heavy tracked vehicles equipped with dozer blades, and, in some cases, armored personnel carriers.

d. As soon as possible, this route should be improved by bulldozers pushing off broken timber and, in winter, the excess snow. The road should be improved to carry all of the tracked equipment in the brigade trains and be at least one lane wide with sufficient turnouts to accommodate some returning traffic. At times, these bulldozers may have to deviate slightly from the route selected by the reconnaissance unit to avoid open water and excessive slopes. However, the MSR, capable of carrying all tracked vehicles of the brigade, will normally follow the general route selected by the reconnaissance unit.

20. Time Lag

a. In addition to the increased amount of time consumed in actual movement, allowance must be made for other time-consuming tasks not present in normal operations. These time-consuming tasks normally increase the time between issuance of a march order and the start of its execution. Every effort should be made to compensate for this time lag by early issuance of warning orders and fragmentary orders.

b. Upon receipt of the march order, men must adjust their clothing and equipment. Frequently, this will save unnecessary halts for adjustment of clothing, rucksacks, skis, or sled loads. The leaders must ensure that the men do not overdress, thus increasing the possibility of overheating and exhaustion.

c. The unit leader must assure himself that every piece of necessary clothing and equipment is present and in serviceable condition. Although this becomes routine, it is still time consuming.

d. Movement will be slowed while operating in low temperatures because heated shelters (tents with stoves and fuel) must be transported with or by the troops. Time is consumed in striking shelters and loading equipment. Similarly, when the march is completed, camp sites must be prepared, tents erected, and stoves put into operation. Although considerable time is consumed in pitching and striking tents, experience has taught that it is still less time consuming to utilize this transportable type shelter than to construct improvised shelters. Improvised shelter should be constructed only when other shelter is unavailable. During the cold season, shelters are not struck until the last possible moment prior to beginning the march, so as to provide heat and shelter as long as possible.

e. If vehicles are to be included in the march column in extreme cold, sufficient time should be allowed for starting and warming their engines. Engine starting and warmup procedures are prescribed in TM 9–273 and TM 9–207.

f. Trailbreaking detachments, which move at a slower rate than the remainder of the march unit, should be started soon enough to avoid delaying the main body.

Section IV. INTELLIGENCE, PATROLLING, COUNTERINTELLIGENCE, AND SECURITY

21. Combat Intelligence

a. In addition to the essential elements of information required for other types of operations, answers to at least two important

questions are necessary to successful winter operations in the north. The questions are —

(1) What is the enemy capability for moving cross-country?
(2) What is the enemy capability for living and fighting for prolonged periods in extreme cold?

b. A checklist to assist in determining the answers to these two questions might include —

(1) Is the enemy equipped with skis or snowshoes?
(2) What is the enemy status of training in their use?
(3) Does the enemy have oversnow or through the snow vehicles? What kind?
(4) Does the enemy have any snow removal equipment? What kind?
(5) What types of artillery are being used by the enemy (SP or towed)?
(6) Are guns ski-equipped?
(7) Is the enemy using sleds or some other type of oversnow transport to move unit equipment?
(8) Is the enemy using heated shelters? What kind?
(9) Can shelters he moved cross-country without vehicles?
(10) Is the enemy using improvised shelters?
(11) What type of winter clothing is used by the enemy? What protection will it afford?
(12) What kind of weapons does the enemy have? Are they effective in extreme cold? What is their effect in deep snow? Can their heavy weapons follow infantry units in cross-country movements?

c. For summer operations, units should determine if the enemy has cross-country vehicles capable of negotiating muskeg or swampy terrain; if he has boats and is using them and for what purposes; and if he has bridging equipment and units.

d. Detailed knowledge of the terrain and climatology of the area of operations is essential. The location and condition of the existing road net, if any, must be determined. Information regarding soil trafficability, vegetation, water routes and expected ice thickness, snow conditions, and average snow depth should be available to the commander. The general features of the terrain from the viewpoint of cross-country movement should also be known by the commander. For summer operations, it will be necessary to determine water routes suitable for transportation and dry ground routes in barren lands.

e. The increased effect of weather on military operations in northern latitudes makes it essential that continual and accurate weather forecasts be rapidly disseminated to the lowest level.

f. Collection agencies are essentially the same as for temperate zone operations although their methods of operation may be

different. There is greater opportunity for patrols to work behind enemy lines in gathering information. Increased emphasis must be placed on effective use of air reconnaissance by both Army aircraft and the supporting Air Force units. During seasons when waterways are open, boat patrols are useful in gathering information.

g. It is especially important during the planning phase of northern operations to secure detailed information of the operational areas from strategic intelligence agencies. Every effort should be made to procure basic air photo coverage of the area for each season. Streams, lakes, swamps, and the general conformations of the ground may show clearly on air photos taken during warm months but may be extremely difficult to distinguish on air photos taken when waterways are frozen and the ground is covered with snow.

h. After operations are initiated, some collection means, such as long range patrols, lend themselves to more than usual exploitation in obtaining information deep in enemy territory. Because of the unusually great operating distances, these patrols can often pass undetected through flank and frontal areas. Indigenous personnel assume increased importance as a source of information.

22. Patrolling

a. Patrolling to provide information of the enemy and to provide security increases in importance since combat units will seldom have any close neighboring units.

b. Reconnaissance patrols may operate far behind enemy lines for extended periods. In winter, the oversnow mobility of patrols must be given prime consideration. Ideally, only ski-qualified personnel, equipped largely with individual automatic weapons, should be used. However, snowshoes provide an adequate and reliable means of oversnow movement and their use allows greater latitude in the selection of personnel. Personnel will also carry necessary communications equipment, antipersonnel mines, and minimum essential equipment (such as shelter halves or ponchos) to construct improvised shelters. They will require light weight rations. Prearranged supply drops in enemy territory may be used for replenishment of supplies.

c. The most economical way to move long-range patrols into enemy territory is by aircraft. At times, it may be feasible to pick up patrols from enemy rear areas by aircraft. During winter, escort patrols should be sent with long-range ground patrols to insure that the long-range patrols get through enemy lines, to carry additional rations for later use by the long-range patrols,

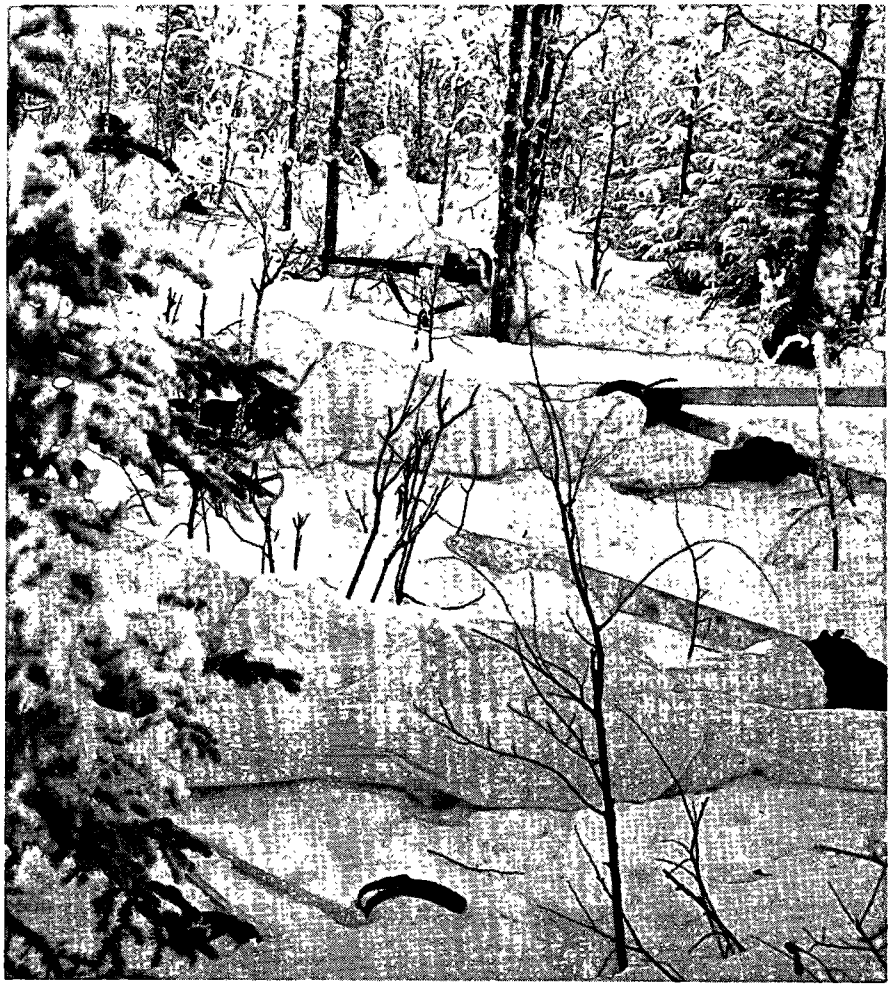


Figure 8. Winter camouflage.

and to make deceptive tracks on both sides of the route of the long-range patrol.

d. Aerial combat reconnaissance forces with armed helicopters are ideally suited for security and reconnaissance in northern operations. Speed, mobility, and firepower enable them to perform many of the missions formerly assigned to cavalry units.

23. Counterintelligence

a. Camouflage.

(1) Camouflage during the winter is exceedingly difficult. Reliance should be placed on deception techniques. Commanders must place special emphasis on camouflage and deception techniques (fig. 8).

(2) Summer camouflage techniques do not differ from those applicable in temperate zones.

b. Deception. Deception has an important role in northern warfare. False ski or snowshoe trails are made to mislead the enemy as to size of the force, direction of movement, and scope of activity. Open camp fires can be started in dry tree stumps in many locations to deceive the enemy as to size and location of forces. Dump gun positions can be constructed from materials at hand. Sound and flash simulators should be used in these positions to give them a semblance of reality. If dummy rubber vehicles and weapons are not available, snow and logs can be used as substitute materials. All deceptive measures must be well planned and carefully executed to give them every appearance of reality.

c. Concealment.

(1) Excellent concealment for troop movements is afforded by darkness, fog, or falling snow. In forests, clearings are avoided, and troops and vehicles leaving roads should do so only in places where the forest is near the road.

(2) In bivouac areas and supply points maximum use should be made of dispersion and vegetation for concealment.

Section V. OFFENSIVE OPERATIONS

24. General

a. Ground offensive operations are directed toward the destruction of the enemy in the least possible time. Actions will be sudden, violent, and decisive. An operation which is permitted to lag may result in a stalemate or may offer an opportunity for the enemy to seize the offensive. Both forces retain freedom of maneuver limited only by their ability to cope with the climatic and terrain conditions. Due to large operational areas, flanks and rear areas are usually lightly defended and present excellent opportunities for envelopment, or under favorable conditions, for turning movement.

b. Existing lines of communication must be controlled to assure success in northern operations. Severe winter weather hastens enemy destruction after supply lines are cut. Breaches in enemy lines of communication should be made in the vicinity of dominating terrain if retention of the area is required. During summer, such objectives should be selected where the lines of communication cross a river or pass between two existing natural obstacles.

c. Effective utilization of weather conditions increase opportunities for surprise attacks. This includes the exploitation of

falling snow, blizzards, fogs, low cloud cover, and natural night illumination. Imaginative use of what appear to be weather obstacles may turn them into major advantages. However, conducting offensive operations during severe weather conditions will restrict the use of aviation support and increase control and reconnaissance problems.

d. The assault should be conducted during periods of low visibility. Surprise is an important factor, and the opportunities for achieving surprise are numerous. It may be preferable to deliver the assault without artillery preparation fires.

e. A period of slow movement may occur between the cessation of artillery fire on the enemy forward positions and the arrival of the infantry on the objective. This period of slow movement caused by weather or terrain conditions must be considered in planning fire support of the assault. However, when weather, terrain, and lack of effective enemy resistance permits, mechanized infantry may remain in their carriers and make a mounted assault to capitalize on shock effect and reduce the time lag associated with a dismounted assault through snow and underbrush (fig. 9). To further enhance this capability, tanks lead or accompany the mounted assault.

Figure 9. Personnel carrier in brush.

f. After seizing an objective, immediate attention must be given to organizing the position for security. The assaulting troops may be fatigued and overheated from the exertion of the attack. Provisions must be made to prevent them from becoming cold casualties.

Figure 10. Airmobile operation.

g. Army fixed and rotary wing aviation can be effectively integrated into offensive operations. Vertical envelopment, diversionary attacks, and rapid displacement of supporting weapons and reserves are within the offensive capabilities of an airmobile force (fig. 10). Low troop density throughout the battle area plus flexibility in route selection reduce the hazards of enemy operations and counter action against movement.

25. Main Attack

a. The opportunity for maneuver is usually present in northern operations. Main attacks are usually directed against the flanks or rear areas while supporting attacks are directed against the enemy front to hold him in position. An additional force may be employed to bypass the enemy position and cut enemy routes of reinforcement or withdrawal.

b. The most mobile troops are used to breach the enemy lines of communication.

26. Control Measures

Axes of advance are normally used as control measures. Boundaries may be used if close lateral control is necessary and terrain permits designating discernible boundaries. In barren, flat terrain, an azimuth may be used to indicate the direction of movement. Intermediate objectives and phase lines are assigned as necessary to control the attack and seize key terrain.

27. Coordination

Coordination is extremely important in northern operations. At times, the distance between two enveloping forces may become so great that messages must be relayed. The radio relay capability of Army aircraft permits significant extension of the range of ground tactical radio equipment.

28. Attack of an Organized Position

a. Commanders inform their staff officers as early as possible of the concept for the attack, so that an attack order can be issued as far in advance as possible. This applies in particular to the logistical officer whose arrangements for logistical support are most likely to require additional time in northern operations.

b. Reconnaissance is initiated early on a wide front with missions of determining enemy locations and reconnoitering routes and terrain, including terrain in enemy hands.

c. Harrassment of the enemy is started simultaneously with reconnaissance and is executed by patrols, limited objective attacks, and interdiction by aircraft and artillery.

d. Prepared fires of supporting artillery and mortars are closely coordinated. Representatives of supporting artillery are included in infantry reconnaissance patrols and in combat patrols. Preparation of firing positions for supporting weapons is begun early as it is likely to be time consuming.

e. Engineer reconnaissance troops should be included in infantry reconnaissance patrols. Bridging equipment and materials are moved well forward to be ready for use when needed.

f. The communication plan is made in detail and must provide measures for overcoming difficulties peculiar to northern operations.

g. Supply reserves are kept mobile when possible. It may be necessary to establish distributing points in forward areas.

29. Preparation for the Attack

a. When reconnaissance is completed and other preliminary measures taken for the attack, trails are opened to assembly areas. If the distance is not too great, these trails are not opened until the day before troops plan to move. Wire communications, when used, are laid simultaneously with breaking of trails.

b. Movement to assembly areas is executed the night before the attack unless conditions of low visibility deny enemy daytime observation. Guides must be provided.

30. Movement to Line of Departure

A halt is made in the assembly areas only long enough to feed and prepare troops for the attack. Vehicles are dispersed and artillery moved to prepared positions and camouflaged or concealed. Troops remain in the assembly area for the minimum length of time necessary to prepare for the attack. Supporting weapons are moved to selected firing positions.

31. Conduct of the Attack

a. The attack may be conducted by the Infantry on foot, skis, or snowshoes or transported by tanks or personnel carriers. Techniques of conducting the attack are as in normal operations, except when troops are using skis or snowshoes.

b. When the attack is conducted on skis or snowshoes, four or five men follow the same track as they move over the line of departure. Every attempt is made to get as close as possible to the enemy before delivering assault fire. Troops do not disperse or halt to fire until reaching the assault position or enemy fire becomes effective. Final coordination lines should generally be closer to the enemy during winter than during summer especially if the assault is made on foot through snow. The decision as to whether the assault is to be conducted on skis, snowshoes, or foot must be made by the commander based upon existing conditions. If skis or snowshoes are removed in the attack they should be brought forward during reorganization.

c. In continuing the attack, special efforts are directed toward rapid displacement of close-support weapons using sleds or vehicles. Supply routes are prepared as far forward as possible to facilitate unit distribution.

d. The relief of committed units is executed as under normal conditions with consideration being given to rapid relief of assault elements to bring them back to warm shelter. Warming tents, if needed, are moved to the closest available concealment by each unit responsible.

32. Pursuit

The exploiting force is aided by cross-country vehicles and tanks. The pursuit force, which must have high mobility, is mounted on skis, vehicles, or helicopters. Airborne or airmobile troops are positioned near defiles to block the retreat of the enemy. During summer, waterways may be used by the pursuing force as a means of moving patrols behind the enemy to destroy bridges and erect road blocks along the enemy lines of retreat.

33. Security in the Offensive

When attacking units have large gaps between them and flanks are vulnerable, patrol and surveillance requirements increase. Basically, however, security requirements in the offense during northern operations is no different than requirements in more temperate zones.

Section VI. DEFENSIVE OPERATIONS

34. General

a. The defensive is assumed for the same general reasons as in other areas plus some northern phenomena, such as breakup or freezeup seasons, severe snow storms, or extremely low temperatures. The defense may also be assumed to force the enemy to attack under unfavorable conditions, such as in long, narrow passes or through deep snow and obstacles where movement is difficult.

b. Defensive actions are difficult in extreme cold because of the requirement to keep troops warm and in condition to fight. However, improved opportunities for the success of the defense and counterattack exist since an enemy force may be exposed to the elements if warming equipment and other logistical support has not accompanied the attacking enemy force. The breakup season is favorable to the defender as trafficability is poor for the attacker.

c. Conduct of the defense under northern conditions is the same as under other conditions. The tendency to remain shelter bound must be resisted. Strong combat patrols are used to harass the enemy flanks and rear.

d. All-around defense is essential since attacks may be launched

from any direction. During spring, summer, and fall a mobile defense is extremely difficult because of trafficability.

e. Routes of supply are often attacked by enemy patrols, therefore, supply personnel must be capable of defense at all times. In rear installations, area security and damage control plans are made and a warning system established. Special attention is paid to possible landing areas, such as lakes or rivers. When necessary, combat units will furnish escorts for supply columns.

f. Defense positions located in deep snow suffer less from the effects of enemy fire. Dense forests, thickets, fallen timber, cliffs, and other natural obstructions collect snow and create obstacles to the attacker. Rocks and fallen tree trunks may become tank obstacles. The effectiveness of natural terrain obstacles can easily be increased. The enemy use of frozen waterways can be denied by laying mine fields in ice as described in FM 31–70.

g. Tents are sunk into deep snow or into the ground and protected by embankments. If the defense is to be of long duration, heated underground shelters are constructed and tents are eliminated. Medical aid stations and command posts are also located in underground shelters for protection from enemy fire. Warm shelter is constructed for reserves. Areas in the defense where there is little snow, or which are easily traversed by the enemy, are reinforced with artificial obstacles such as wire entanglements (specially concertina wire), pitfalls, abatis, antitank mines, and antipersonnel mines and are covered by fire. Deception techniques are practiced extensively. Seasonal changes will affect defense positions. The breakup season will usually destroy positions built during the winter. Positions or obstacles built during the summer may be made useless by heavy snow fall.

h. Special attention must be directed toward maintaining battle preparedness in winter. While resting in forward positions, men must be ready for combat. Constant care must be taken that all weapons are prepared for immediate use. Firing positions must be kept clear of snow. Guards are rotated and inspected constantly.

35. Defense Positions

Strong points should be located in elevated terrain. The value of elevated defense positions is greater during winter than under normal conditions as the enemy must attack up hill in snow.

36. Security

Proper security of a defensive position requires the location of living and fighting positions for the security force on the outer perimeter. A warning system is established from the sec-

urity force position to the forward defense force position. All movement on the outer edge of the perimeter and in the vicinity of the living-fighting positions is kept to a minimum to preclude observation or attack by hostile air and ground forces.

37. Composition and Location of Reserves

An aggressive defense requires the formation of a proportionately large reserve with maximum cross-country mobility. Individual oversnow equipment, oversnow vehicles, personnel carriers, or helicopters are used to obtain this mobility. Dismounted reserves must be stationed closer to defense positions, while mechanized or air mobile reserves may be stationed farther away. In selecting a location for the reserve, consideration must be given to the importance of rest as well as to the probable area of employment. The major portion of the reserve is placed in covered and concealed positions, protected from enemy light artillery fire, while the remainder may be placed closer to the front lines. Trails and roads to the probable points of action are prepared for the reserve troops and are kept open during snow storms by elements of the reserve.

Section VII. RETROGRADE MOVEMENTS

38. General

Retrograde movements are executed as in normal operations. In the north, suitable conditions are frequently present for leaving strong combat patrols up to a strength of one or two platoons to harass or ambush the advancing enemy. Surprise attacks can be launched against columns of vehicles and troops at natural defiles. In some cases, it may be desirable to establish hidden caches of food and ammunition prior to withdrawal for the use of troops left behind to ambush the enemy.

39. Withdrawals

Withdrawal is best effected at night or under conditions of reduced visibility when enemy reactions are slowest. Trails are broken rearward from positions before withdrawal commences and may be mined as the rear guard withdraws. If a daylight withdrawal becomes necessary, smoke may be used to good effect. Oversnow mobility is exploited to the maximum. During the withdrawal, troops destroy all abandoned shelter that can be used by the enemy. Maximum use is made of mines, traps, and abatis.

Section VIII. SPECIAL OPERATIONS

40. Raids and Rear Area Operations

a. General. In northern operations there are usually no continuous fronts. Units may operate independently many miles apart. Installations and communication centers are often isolated. Lines of communication, where they exist, are long and vulnerable to attack. Surprise is always a possibility, and security can only be guaranteed by accurate knowledge of enemy disposition, composition, movement, capabilities, and constant vigilance. The enemy is equally vulnerable. Conditions, both operational and environmental, facilitate raids on communications centers, headquarters, and installations of all types. Patrols and stay-behind forces are well suited for these operations. Severe weather conditions enhance the effect of such operations.

b. Tasks.

(1) The primary tasks of long-range patrols will be reconnaissance missions and raids in enemy rear areas. Their operation will be supplemented by the activities of small groups, airdropped or air-landed, for special or long term destruction and intelligence tasks.

(2) As an integrated part of overall planning, combat patrols will be used in the attack, for wide encircling movements to ambush and harass enemy flanks and communications and to report on and obstruct the movement of enemy reserves.

(3) In retrograde movement, stay-behind forces may be left to ambush reserves, destroy lines of communication, mine defiles, and demolish bridges. They will obtain and transmit information on enemy strength, composition and activity.

c. Control. Patrols and enemy rear area operations must be part of the overall plan. For this reason, control must be vested in the commander responsible for their area of operation. When the tactical situation demands, special arrangements must be made for cooperation with, and recognition by, local troops so as to exploit fully the tactical potential of special operations groups.

d. Composition and Employment.

(1) Long-range patrols have no fixed organization. Their strength, organization, composition, and equipment are determined by the particular mission.

(2) Operations can be carried out in all weather and throughout all seasons. In the winter, skis or snowshoes will be used. In summer, movement on foot is possible in most areas.

(3) The great distances necessitate increased use of aircraft for the transport, supply, and the evacuation of patrols, casualties, prisoners, or documents.

(4) Patrols must be capable of rapid movement on foot or skis over long distances and must be able to operate without resupply for long periods. To achieve this standard, a rigorous reduction in the weight of equipment and rations is necessary. The weight and number of arms must be kept to a minimum and fire power must be obtained by use of lightweight automatic weapons and grenades. Communication with the base is by long-range radio.

e. Selection of Personnel. The effectiveness of long-range patrols and intelligence groups, fundamentally, depends on their ability to live under rigorous conditions and on the speed with which they can move across country. High powers of endurance and expertness on skis or snowshoes are of paramount importance. In addition, every man must be proficient in all those subjects classified generally under the term "bushcraft." Personnel must be specially selected from men with a wide practical experience in the northern regions and be, if possible, volunteers. Included in each group should be at least one person with a knowledge of the language, the people, and terrain of the combat theater.

41. Combat Under Conditions of Low Visibility

a. General.

(1) In the unforested regions and those areas where natural concealment of any sort is scarce or entirely lacking, it becomes increasingly important that troops be well trained and familiar with operations both at night and under conditions of low visibility arising from blowing snow, mist, or fog.

(2) Conditions of low visibility provide the greatest opportunities for surprise. Commanders must insure that weather forecasts and reports are constantly distributed as a matter of standing operating procedures.

b. Night Combat.

(1) Normal night combat techniques apply unchanged. Movement and control are facilitated by the increase in visibility resulting from the reflection from the snow. During a cloudy night, light conditions correspond approximately to those on a clear night, to those with a full moon in country without snow cover. On windless nights during periods of extreme cold, sound carries

for great distances. Under such conditions, all troops must realize the need for silence. Otherwise, surprise is impossible to achieve and security difficult to maintain.

(2) If the snow has thawed during the day it usually freezes at night making movement noisier but easier than by day. During the spring breakup, daytime thawing will usually restrict the use of roads to night hours.

Figure 11. Snowstorm.

c. Combat During Snowstorms.

(1) Combat operations are sometimes assisted by high winds and snow storms which cover sounds and obscure movement (fig. 11). Close reconnaissance and attack are possible under the cover afforded by such conditions. The associated high windchill (fig. 24) and the lack of visibility demand a high degree of training on the part of all troops. Compact formations, simple plans, detailed instructions, limited objectives, and positive means of identification should be employed.

(2) Accurate timing is required so that troops do not remain exposed for prolonged periods of time. If the windchill factor is high, the attack should be carried out downwind, if possible, forcing the enemy to face into it.

(3) In the defense, particular precautions against surprise must be taken during blizzard conditions. The number of listening patrols must be increased and continual checking will be necessary to insure that sentries maintain vigilant watch, particularly to the windward and most dangerous flank.

d. Combat Under Whiteout and Fog Conditions. In snow-covered terrain, ground irregularities are visible only by the shadow they cast. Under overcast the contrast is diminished, and in whiteout or fog it disappears entirely. Movement under such conditions is extremely difficult, and progress is appreciably reduced. In hilly or mountainous country, it may be dangerous since angles of slope cannot be estimated nor can changes be recognized.

e. Recognition. At night and under other conditions of low visibility, there is marked difficulty in distinguishing friendly from enemy troops when both are wearing white. Distinctive markings and signals are necessary.

42. Mountain Operations

Mountain operations are discussed in FM 31–72.

43. Inland Waterways Operations

a. Inland Waterways. The northern regions are characterized by a vast network of rivers, lakes, and canals with sufficient depth to accommodate shallow draft waterway traffic. In the absence of road and railroad nets, these natural arteries may be a highly valuable complement to overland transportation, both in summer and winter. For summer operations, some inland waterways of North America and Eurasia are navigable for thousands of miles. In winter, these waterways become ice routes. Waterways may be used for avenues of approach, reconnaissance, troop transport, and movement of supplies.

b. Inland Waterway Craft. Inland waterway craft are characterized by shallow draft, good maneuver capability, and minimum clearance. The craft may be self-propelled or towed, with or without cargo-carrying capability. In addition to the types of crafts used by the Corps of Engineers for the tactical movement of troops and their accompanying supplies in river crossing operations, the movement of troops with supplies requires a

different type vessel for northern operations. Native boats of various types can be used for inland waterways operations. River boats presently in operation are approximately 9½ meters long and weigh between 600 to 900 pounds (fig. 12). They have a maximum height of 70 cm and a loaded draft of about 25 cm. They are ruggedly constructed, quickly and easily repairable, and can be maneuvered at high speed in swift water. They are capable of carrying an infantry squad fully equipped (total payload 4,400 lbs.) and include a lift to raise the motor over obstructions when in shallow water. With a minimum of a 25 hp outboard motor with a short shaft, these river boats, normally, can navigate any of the typical rivers found in the northern regions.

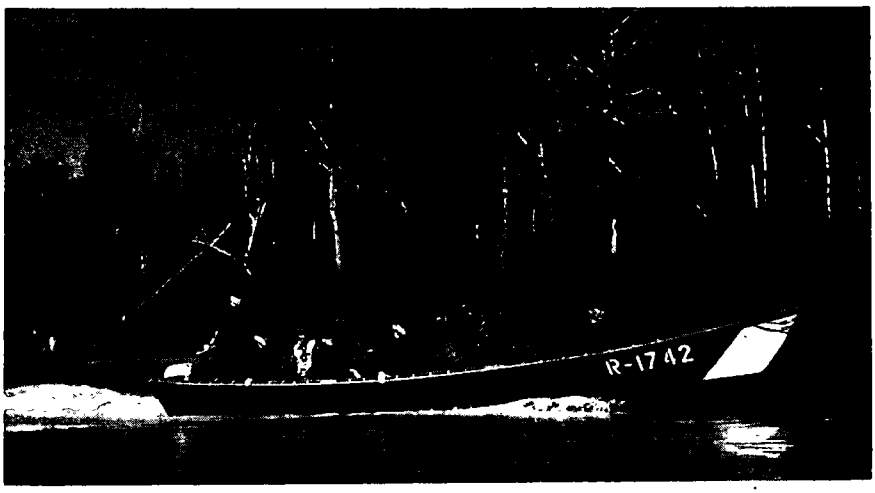


Figure 12. River boat.

c. Inland Waterways Operations.

(1) *Advantages.*

(*a*) In areas with limited road and rail nets, water can often be utilized advantageously as an alternate means of transportation.

(*b*) Many areas of the north are inaccessible during the summer months except by air or water.

(*c*) Large scale movements of troops and supplies can be accomplished with a minimum of fatigue to the operating personnel.

(*d*) Movement by water is one of the most economical means of transportation. In addition, bulky or heavy items, that are difficult to transport by other means, may be readily moved by water.

(2) *Disadvantages.*

(*a*) Waterways are subject to freezing with the resultant immobilization of all traffic unless the ice conditions permit the establishment of winter roads on the ice.

(*b*) Waterways are inflexible. Although canals have been dug to link other bodies of water, this is not feasible in military operations. The manmade features such as locks, bridges, cuts, and dams along waterways are vulnerable to destruction and, if destroyed, will create obstacles to movement.

(c) Flooding may submerge or sweep away landing sites (piers, docks, etc.). During flood periods the current may increase to a torrent. It may, in meandering stream-beds, clog existing channels, cut new ones, or deposit shallow banks in channels and backwaters.

(*d*) Low water, which frequently occurs in late summer, may reduce the channel depth below the minimum requirement and reduce or temporarily eliminate the usefulness of the waterway as a means of transportation.

(*e*) Portage roads, and even small trackways, must be constructed and utilized to avoid barriers formed by rapids, or to link with other bodies of water. Time permitting, the installation of dams and locks to raise the water level may eliminate or decrease the requirement for portaging.

(*f*) Waterway craft is vulnerable to enemy air activity, particularly during long daylight conditions.

(3) *Techniques.* Techniques of waterway navigation, river reading, handling of outboard motors, and maintenance of boat equipment are covered in FM 55–57 and TM TM 5–8081.

44. Operations on Permanent Ice and Snow Covered Areas

a. Operations on permanent ice and snow covered areas may be required for the establishment of support and for protection of specialized activities. In such instances, operations will normally involve small units, but the total effort required will be largely because of the extreme difficulties of operating in such areas.

b. Operations on an ice cap are so different from the other areas of the Arctic that different techniques of operation are required. The absolute absence of usable resources necessitates that every item required for operation be transported into the operating area. It is mandatory that personnel be provided with

protection from the high winds and extreme cold. As a result, support requirements will be extremely high.

c. Specialized equipment for negotiating the areas is required. This equipment will include snow tractors, low-ground-pressure vehicles, crevasse detectors, trailmarking equipment, navigational aids, living wanigans, and related items.

Section IX. JOINT OPERATIONS

45. Amphibious Operations

a. General. The extremes of weather may impose upon an amphibious attacking force conditions which severely limit, or make impractical, an amphibious assault against a defended beach in northern latitudes. The range of high and low tides and beach gradient present in the north must be carefully considered in planning operations. Once the attack is initiated, speed in landing troops and providing logistical support is of great importance. Logistical plans must include an alternate plan to supply by air should ice conditions change during a critical part of the operation. Plans should include the use of helicopters in an amphibious assault. Once ashore, the conduct of the operation will be the same as for any other attack in northern latitudes. FM 31–12 contains the basic guidance for an army force participation in an amphibious operation.

b. Factors Influencing Amphibious Operations.

(1) *Oceanographic Conditions.*

(*a*) Sea ice is one of the factors affecting amphibious techniques in their adaptation to northern conditions. In any amphibious operation within sea-ice areas, the amphibious task force commander should be given great latitude in determining where and when he should attack. Positive air protection must be provided as the force will be limited in evasive action. The force will probably be accompanied by ice-breakers, and progress will be slow. Amphibious operations wherein ships are required to enter an icepack may have to be abandoned as impractical because shifting ice may close leads, immobilize ships, restrict landing areas, and, in some cases, form pressure ridges which are impossible, or extremely difficult, to negotiate.

(*b*) Within ice free areas, no departure from standard amphibious techniques is required except as the operations may be affected by climatic conditions and operating conditions ashore.

(*c*) Unnavigable ice consists of pack ice or landfast ice fields that are either impenetrable or penetrable only by the largest and most powerful icebreaker. Under such ice conditions an airmobile assault from ships can be used. In this case, the operation will be limited tactically and logistically in accordance with the limitations of the planes and helicopters. Another method is to use landing craft to move troops to the edge of the icepack for subsequent movement across the ice against an objective. Under these circumstances, the operation may be of a limited nature since only lightly-armed, swift-moving, well-trained personnel can be used. Logistical support normally will be by air.

(*d*) Marginal ice areas include those areas that are negotiable by light icebreakers and areas free from pack ice but subject to drifting ice and scattered ice floes. This ice is continuously moving because of the wind and ocean currents. If a landing is to be executed within the pack area, the task force commander must determine when to attack, basing his decision on ice conditions.

(2) *Effect of Northern Conditions on Personnel and Equipment.*

(*a*) During the beach assault, waterproof suits must be provided troops and crews of landing craft to protect them from sea spray and, if a dry ramp landing cannot be made, from freezing sea water. Operation of all mechanized equipment, boats, amphibian tractors, and aircraft in subfreezing temperature is difficult. Provisions must also be made for freeing the landing craft ramps should they freeze during the movement ashore. Amphibian wheeled vehicles of the LARC type are unsuitable for landing operations either afloat or ashore due to the fragile hull and the low trafficability of soil ashore. Therefore, the use of amphibian tracked vehicles is emphasized for the movement of both troops and supplies from ship to shore.

(*b*) Shore party operations may be restricted and efficiency reduced by low temperatures, since stations will be required for the exchange of wet clothing and for warm-up purposes. In shore-to-ship evacuation, casualties must be protected from the cold, sea spray and sea water. Consideration should be given to

beaching an LST or similar vessel for the use of the shore party as protection from weather.

46. Supporting Arms

a. Operation of the supporting arms, such as naval gunfire support ships and air support, both land and sea, will be hampered during periods of low visibility and during the long winter darkness. Considerable reliance may have to be placed upon electronic means for directing fire support.

b. The practicability of employing naval air is dependent upon the ability to provide necessary close range supporting bases, generally an aircraft carrier, which in turn must depend upon icefree conditions of the sea for vitally needed maneuverability. Because of the difficulties imposed upon air operations in northern areas, the highest degree of coordination is necessary between naval air and the forces it is supporting. Among these difficulties are the following:

(1) Periodic decrease in visibility and adverse weather in northern maritime theaters limit air-ground support operations.
(2) Lack of proper charts, identifiable terrain features and low visibility, and scarcity of good weather forecasts.
(3) Atmospheric disturbances which increase the communications difficulties for coordinating air with amphibious or land operations.
(4) Longer periods of maintenance and preparation.
(5) Heavy and cumbersome clothing which reduces efficiency of personnel.

c. Naval gunfire will operate with little decrease in efficiency expected in temperate zones. The temperature can be controlled on ammunition, such as the VT fused projectiles, enabling the ship to fire without encountering the difficulties experienced by the artillery.

47. Supply by Water

a. A northern supply expedition by water, during ice-free periods, is less difficult to execute than other methods of supply transport. Ships are self-sufficient, requiring no servicing or refueling facilities at their destinations. Supplies can be delivered on a large scale with a minimum of hazard to personnel and equipment as compared with other methods. Water movement provides bulk supply possibilities not found in any other form of transportation.

b. In the ocean areas of the north, movement possibilities vary widely from year by year depending upon the severity of the preceding winter season. However, most areas of the Arctic Ocean bordering on land masses have about ten weeks each year when the ice permits passage of vessels. These periods usually occur during July, August, and September.

c. (1) The short summer season is usually long enough to melt most of the ice and snow on the land areas and to break up the southern most portions of the polar icepack for several weeks. Poor visibility restricts observation, which is essential to picking a way through drift ice and the icepack, and also hampers cargo discharge when vessels must anchor several miles from shore. To guide landing craft which are discharging cargo, marker buoys are placed along the entire route from the ship to the shore.

(2) Navigation is restricted by the movement of the icepack, which is governed by winds, tides, and currents. Aerial observation by helicopter is essential for icebreakers because of the rapidly changing ice conditions. When the huge floes and chunks of ice are frozen together or packed solidly by the wind and currents, the most powerful icebreaker is unable to force passage. Navigation is further hampered by the prevailing shallowness of the water off Arctic Ocean shores and the numerous, migrating sand bars which prevent vessels from standing in close to shore to avoid heavy ice and to discharge cargo. A serious lack of adequate hydrographic data is an additional hazard.

(3) Cargo discharge is retarded by the lack of sheltered harbors, the absence of wharves and piers, and the distance the vessels must anchor from shore. Consequently, more equipment and manpower is needed than under ordinary circumstances since, in a matter of hours, the icepack may change so that the exit to clear water is blocked. Timing of the operations is another governing factor to overwater supply, because the period of open water or accessibility of installations varies from year to year, supply expeditions must be on hand to take advantage of the leads and breaks in the icepack as they occur.

d. For operation on inland waterways, the principal equipment consists of towboats and cargo barges which have varying capabilities for transporting dry cargo or liquid petroleum products. However, navigation of inland waterways is restricted by

shallow water and with sudden changes in channels due to migrating sand bars and ice action. There are also occasional spots which may require portaging.

48. Airborne Operations

a. General. Basic principles, procedures, and tactical doctrine of current field manuals, applicable to the several phases of joint operations in temperate climatic zones, remain basically the same for similar operations in northern regions. However, certain environmental factors introduce complexities which make their application more difficult. Many military operations in the north may be forced to depend on air transport as the principal, or possibly the only, means of transportation. The guidance contained herein should be applied in conjunction with basic doctrine published in FM 57–10.

b. Seasonal Operations and Weather Effects.

(1) In winter, the extreme cold conditions require more detailed planning in northern airborne operations.

(2) During summer, in most respects, conditions are similar to those in temperate zones, however, there are some significant exceptions.

(*a*) Hours of darkness are extremely limited. The number of hours of daylight must be considered for long range planning (fig. 2).

(*b*) Water temperatures are low. In some areas, troops landing in water could become cold casualties.

(*c*) Airborne operations in the summer months may call for specialized equipment, training, and techniques. Much of the area is mountainous, and operations here may require climbing equipment and climbing techniques. Requirements may also exist for winter equipment if fighting in higher terrain.

c. Capabilities and Limitations of Troop Carrier Aviation.

(1) The load and range capabilities of standard transport aircraft are reduced because of the added weight of winterization, emergency, survival, and rescue equipment needed in northern areas. Troop carrier aviation is capable of performing all those operational functions within the northern regions which are performed in temperate climates, provided satisfactory airfields and cold weather equipment are available.

(2) Troop carrier aircraft may be used for —

(*a*) Transporting personnel, supplies, and material to any area within operating range where airfields and landing strips are available. These airfields can be

either prepared fields on land surfaces or ice surfaces on lakes, streams, and seashore ice which have been smoothed and had the snow removed or compacted.

(*b*) Assault aircraft operations.

(*c*) Troop and supply delivery to combat or objective areas by parachute.

(*d*) Air evacuation of troops, casualties, and materiel.

(3) The normal limitations of troop carrier operations apply equally in the north and, in some cases, are further aggravated. Some of these major limitations on troop carriers are —

(*a*) The effect of weather, low ceiling, poor visibility, icing conditions, and low dense fogs.

(*b*) Navigational difficulties caused by inadequate maps and charts and inadequacy of air navigational facilities in many areas.

(*c*) The lack of adequate marshalling areas with warm shelters and suitable troop carrier bases.

(*d*) The few hours of daylight for assault aircraft landing operations in winter.

(*e*) The reduction of the quantities of supplies, equipment, and weapons that can be carried in the aircraft for paradrop.

(*f*) Maintenance difficulties, insufficient maintenance shelters, and decreased personnel efficiency.

(*g*) Difficult starting and warmup operations of aircraft engines that have become cold-soaked.

(*h*) Heavy snow or deep snowdrifts on airfields and landing strips with associated snow removal problems.

(*i*) Accumulation of frost, snow, sleet, and ice on parked aircraft.

(*j*) Difficulties in constructing airhead landing strips in summer.

(*k*) Uncertainty of high-frequency communications.

d. Air Transported Operations. The inadequacy of overland means of transportation dictates the utilization of aircraft for rapid and efficient movement of personnel, supplies, and equipment. Even in those areas where limited facilities for overland transportation are available, air-transportability can contribute to greater unit mobility.

e. Employment of Airborne Forces. An airborne force is capable of rapid and extended employment utilizating current troop carrier aircraft. Troops may be landed in otherwise inaccessible areas by parachute or airlanding. Airborne troops are subject to

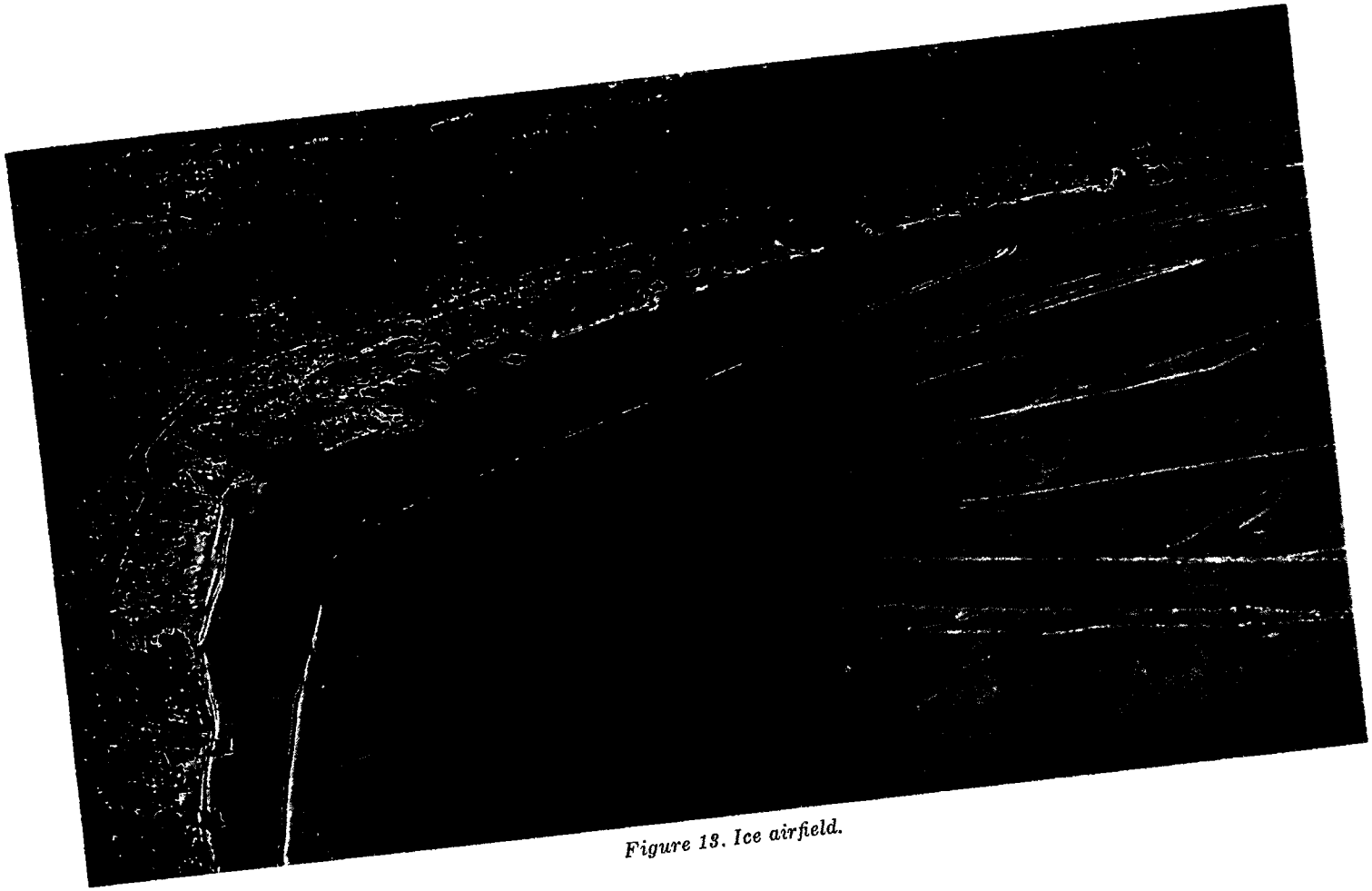


Figure 13. Ice airfield.

the limitations that reduce the capabilities of all tactical units operating in northern regions, but to a greater degree. The primary problem is encountered in supplying airborne units. The delivery of necessary supplies to airborne forces and the distribution of these supplies within the airhead require a great expenditure of time and materiel. In addition, requirements for aircraft may be increased due to the necessity of dropping tents and stoves with troops. Army aviation, when available, facilitates distribution of supplies within the area. Since link-up operations are restricted, airborne forces are more vulnerable to concerted enemy air and artillery action during the initial stages of an operation.

f. Drop Zones and Landing Zones. The selection of drop zones (DZ) and landing zones (LZ) are affected by the following considerations:

(1) Visual or photographic coverage. If possible, information should be confirmed by ground reconnaissance.

(2) Swamp and muskeg soil conditions.

(3) Availability of ice of sufficient depths for suitable DZ or LZ on lakes and other water surfaces (fig. 13).

(4) Depth of snow and configuration of drifts.

(5) Location of landing fields so that cold air drainage from surrounding hills doesn't drain down onto the airfield. This subjects the field to considerable ice fog, especially during takeoffs on cold days.

g. Marshalling.

(1) Protective shelters, such as hangars, are needed for the use of troops when they put on their parachutes.

(2) During the loading phase, rapid motor transport should be provided between the marshalling area and the departure field. Properly coordinated loading and rapid aircraft takeoff also help hold to an absolute minimum the time personnel are exposed to cold and other elements. Protective shelters are controlled so that troops will not become overheated in the heavy clothing prior to exposure to extremely low temperatures.

(3) To reduce the effects of slower loading and delays in aircraft departure, plans for loading operations are made to provide for compact aircraft parking near the supply and equipment storage areas.

(4) Equipment and supplies that might be damaged or become temporarily inoperative by exposure to extreme temperatures and moisture are packed in special bundles. Supply agencies at the marshalling area must be

capable of preparing and modifying equipment bundles up until the time final loading is completed. Equipment bundles to be free dropped need special preparation and protection. This may vary with the season. Every precaution is taken to reduce the recovery problem. Even with due precaution, there will be a high loss rate of bundles which are dropped in deep snow or in marshy tundra. Bright colored parachutes and streamers attached to bundles aid in recovery.

(5) When loading, troops are cautioned to keep clear of propeller blast which picks up fine snow and drives it into clothing.

49. Tactical Air Support

a. General. The importance of tactical air support is greatly increased in northern operations, primarily because of the remoteness of northern areas and the lack of suitable routes of supply and communications, and the resulting relative unavailability of normal fire support elements.

b. Fighter-Bomber Support.

(1) Tactical air strikes by fighter-bombers may often be used to supplement fire support normally obtained from organic support means. In extremely mountainous terrain or in glacier operations, air strikes may be the only fire support means available other than man-carried mortars or recoilless weapons.

(2) Movement of forward air controllers to points where they can be control air strikes is a problem in northern operations. Army aircraft, particularly helicopters, are the best vehicles for placing the FAC in a position to see the target and direct the fighter aircraft. Ground transportation, even tracked, is inadequate as it cannot move rapidly from the area of one air strike to the area of another.

CHAPTER 3

COMBAT SERVICE SUPPORT

Section I. GENERAL

50. Purpose

This chapter outlines procedures for combat service support of northern combat operations. Procedures for support of task forces in cross-country operations are emphasized.

51. Factor Affecting Northern Logistic Operations

Logistic support in northern areas is critically affected by:

a. The long and difficult terrain distances over which support must be rendered.

b. The lack of ground communications systems, even in the approaches to population centers.

c. The general lack of civil and industrial facilities that can be adapted for military purposes.

d. Environmental factors, including winter cold, low-bearing-capacity soils in summer, permafrost phenomena, vegetation cover, and terrain barriers.

52. Logistic Mobility

Tactical mobility is limited by logistic mobility. Logistic mobility requires rapid, convenient, and economical supply storage and handling methods; responsive resupply systems; effective maintenance and service support systems; and effective ground and air transport, all integrated into competent support organizations.

Section II. PLANNING

53. General

Success in combat operations in undeveloped northern areas is dependent on adequate support plans. Every command decision must include full consideration to resources and their accessibility.

a. A task force commander is directly responsible for administrative as well as tactical control of certain logistic elements which in conventional situations operate under higher echelon control. The integration of these elements into his force increases command span and control requirements. Normally it is desirable for the commander to delegate control of all support operations within the task force to a senior subordinate.

b. A force should not move out in northern operations until adequate support plans have been developed. With realistic support plans, the commander can fight in response to the tactical situation as it may develop. If the support, as planned, breaks down in the course of the operation the tactical operation may not succeed.

c. Development of an adequate support plan requires the commander's close personal attention, as well as the participation of the operations and logistics staffs. In a cross-country movement, the operations officer and the logistics officer must formulate concepts and prepare detailed plans jointly and concurrently. The operations officer must understand and accept the limitations of logistic capabilities.

d. Troops committed to northern operations on short notice will frequently be faced with the problem of familiarizing themselves with special items of equipment. Training in the methods of exploiting such specialized equipment to secure the maximum combat capability from its use is essential.

54. Requirements Planning

a. Requirements planning begins with the first stages of operational planning; the lead time required to obtain and issue special equipment establishes a minimum time within which an operation can be mounted. Nonmilitary local supply sources can be exploited in some cases to acquire certain specialized items and thereby reduce requirements lead time.

b. Special equipment is required to afford the combat force adequate mobility and environmental protection. General equipment requirements for northern operations are stated in Arctic Appendices to Tables of Organization and Equipment. In addition to TOE authorizations, Class IV requirements must be determined for each operation according to the terrain, weather, nature of the operations, and planned duration of the operation. In most northern areas, consideration must be given particularly to requirements for cross-country transport for all elements of the combat force and direct support activities.

c. Equipment requirements vary seasonally. Therefore, requirements planning is a continuing activity for planning staffs.

Long advance projection of requirements is necessary to ensure ordering and delivery of special equipment, since northern areas are usually poorly served by strategic transport and large volume deliveries depend upon seasonal shipping.

d. The logistic staff should prepare and keep current a control record of all equipment and support resources under its control and responsive to its requirements. This is particularly necessary when a force is new to northern operations, for, in the absence of such a formal record, important capabilities may be overlooked.

e. Special items of supplies and personal equipment will be limited to those required by the terrain and environmental conditions.

f. A variety of special organizational equipment will be necessary. Certain of these items, depending on the area of operations and weather conditions to be encountered, will be indispensable.

(1) During summer, mosquito netting or screens and aerosol-type bombs will be necessary to provide mosquito and flyproof enclosures for sleeping, eating, and administrative duties. Boats, outboard motors, and low-ground-pressure floatable vehicles for negotiating rivers, lakes, and marsh areas can be utilized to good advantage to provide transportation for personnel and critical supplies.

(2) In the winter season, the extreme cold weather makes it imperative that the organization have on hand a variety of special equipment.

(*a*) The special equipment required for small unit living during the winter season will depend on the depth and characteristics of the snow, extent of vegetation, and other terrain and climatic conditions. It can be expected that most of the following items will be needed; tent, tent stove, 200 pound sled, machete, saw (either buck saw or one-man cross-cut), axe, shovel, and spare ski tips and bindings.

(*b*) At company level, there is a need for additional items such as ski-wax, pine tar or lacquer, pick mattocks, shovels, tent stoves with repair parts, ice augers, iron wire for lashing, nails, cross bars, insulated food containers, cross-cut saws, ice saws, spare ski tips and bindings, extra skis and poles, tent repair kits, casualty evacuation bags, sleeping bags, rope, and spare snowshoes. Low-ground-pressure oversnow vehicles are also required to provide mobility.

(*c*) At battalion and brigade level, the following items

should be considered: auxiliary cold-starting aids (slave kits), air duct heaters, extra battery chargers, antifreeze compounds, special cold weather hydraulic fluids, cold weather lubricants, cold weather batteries, cargo sleds, mobile heated shelter in which to operate the engineer water supply equipment, low-ground-pressure oversnow vehicles, and water pumps.

(*d*) The extra equipment required for heat and shelter, including the clothing each man wears, must be kept within limits which permit transport by manpower alone while still not materially reducing the operational capabilities of the unit. Special means should be provided for transporting the group equipment, whenever possible, to allow each man maximum freedom of action during combat and on the march. This might take the form of tracked cargo carriers or tractors drawing sleds. This transport must operate closely enough to the forward elements to deliver tents, stoves, fuel, and food each night or whenever a long halt is made.

(*e*) In general, it can be expected that increased stocks of repair parts and Arctic lubricants will be needed for all equipment exposed to extreme cold, with the greatest increase occurring with those parts dependent on lubrication for long life. Extreme cold weather reduces the efficiency of lubrication, puts a heavy drain on batteries, results in many materials becoming brittle, and restricts the amount of maintenance that can be accomplished in the open.

(*f*) For operations in extreme cold, maintenance and other combat service support activities require heated shelters, and the continued efficiency of all personnel depends on being able to get into a warm shelter frequently. Accordingly, some type of shelter with heating equipment must be planned for all echelons. This includes tents with stoves for the combat troops in contact with the enemy. Mobility will be restricted by the necessity of transporting shelters, stoves, and fuel; however, the proper types and amount of such equipment will sufficiently increase the efficiency of the command to justify its transportation.

55. Mobility Planning

a. For relatively small forces, construction of an MSR is uneconomical and, by tending to tie support elements to a fixed

Figure 14. Winter bundle delivery.

Figure 15. Movement of supplies.

route, increases vulnerability to enemy behind-the-lines activity. Accordingly, where cross-country transport is available in sufficient quantity, the support plan provides for cross-country movement of the entire force, with exploitation of air resupply to augment the ground cross-country line of communication (fig. 14). Wheeled transport represents a valuable and familiar resource with which the average force is reluctant to dispense. However, since employment of wheeled vehicles in a cross-country movement requires road-building, the diversion of effort to road building ordinarily offsets the gain from the use of wheeled transport. Nonuse of wheeled vehicles involves loss of some supply and maintenance capabilities in the field; the force must accept this loss as the price of effective mobility.

b. Cross-country transport vehicles and rolling liquid transporters are employed to transport Class I, III, and V supplies and essential maintenance services to give the task force the maximum possible self-sustaining capability in the cross-country operation. Nice-to-have services are left behind and all elements of the force are stripped of equipment that reduces mobility.

c. Plans provide generally for use of the most efficient and economical support capabilities before premium methods are used. For example, rolling liquid transporters towed by cross-country cargo transporters should be employed for Class III delivery in preference to drums.

d. Army aviation is employed to supplement ground transport and is used freely when such use results in net economy in effort (fig. 15). For example, the use of helicopters to deliver daily ration issues to forward rifle companies frequently effects a major saving in effort for the battalion. The use of helicopters to return empty rolling liquid transporters materially reduces turnaround time and increases the effective availability of the transporters. However, the use of helicopters for heavy resupply loads such as ammunition is not economical and is avoided in so far as practicable by preplanning and prepositioning supplies.

e. Natural waterways may be used during summer seasons for logistic movements.

(1) Powered boats with shallow draft are employed for both troop transport and supply movements in upstream areas. Near the mouths of large rivers, conventional ship-to-shore lighterage may be used effectively for support of task forces. Amphibious vehicles may be used for bulk hauls upstream where shallows are encountered. Long-distance bulk river transportation equipment of conventional commercial design may be employed effectively.

(2) Some northern rivers are not improved. Use of natural waterways for logistic support movements requires relatively extensive effort for the location of channels and installation of navigation aids. Successful stream navigation requires a detailed knowledge of local conditions by the lead pilot.

(3) When a river line of communication is established, cross-country supply handling and ground transport equipment must be provided to move supplies from the river bank to the supported force. Effective movement control procedures must be established to ensure coordination between waterborne and ground transport equipment. To avoid development of position-betraying logistic complexes at riverside, installations are located some distance from the river bank and unloading points for river transport equipment are moved frequently.

(4) During the winter, frozen river surfaces are not dependable routes of movement. Surface ice thickness varies according to local conditions, including river depth and velocity, the existence of hot springs, range and previous duration of low temperatures, and other factors. In addition, ice movement makes the surface extremely rough and broken in many places. With careful reconnaissance, frozen river surfaces may be used for local vehicle movements and for river crossings. However, during the cold season, it is generally preferable to establish ground routes following the most favorable terrain in river valleys.

f. Successful distribution in northern operations depends upon effective and comprehensive coordination of transport means and supply planning. It is essential that logistic and operational planners be informed at all times of the location and load of all supply transport, of supplies available and planned for lift, and of projected operational support needs. The general support acti-

vity maintains a central record of all air and ground transport committed between general support supply points and the supported force. Within the task force, all transport, regardless of organizational assignment, is centrally coordinated.

56. Rear Area Security Planning

a. The independent task force is responsible for its own rear area. The independent force in cross-country operations does not have a continuous rear zone through which support can move under friendly control and protection. Elements left behind the main body are vulnerable to the guerrilla forces which are characteristic of undeveloped area operations. As the independent force moves, it moves with it all associated activities, including the direct support element, keeping the support tail well tucked in at all times. The task force tactical plan provides for all-around protection of the Task Force perimeter.

b. Specific provisions are made for local defense of each logistic complex, including field trains and the mobile direct support element. All personnel in rear areas are armed and integrated into the local defense plan. Defense plans include provisions for blocking airstrips and other cleared and open areas against helicopter and airborne landings. Support elements not prepared psychologically and by training to defend themselves are highly vulnerable to enemy attack. Support units prepared to defend themselves can withstand helicopter-borne and airborne attack effectively.

57. Low Visibility Operations

Logistic forces must be trained to perform mission tasks at night, in fog, snow storms, and similar conditions.

Section III. ORGANIZATION FOR LOGISTIC SUPPORT

58. General

a. Organization

(1) When major units are employed conventionally, the normal logistic support organization is employed. Logistic operations in northern areas differ from temperate zone operations only in the techniques of adaptation to the environment.

(2) When brigade or smaller task forces are employed independently, general support is provided on an area basis and direct support is provided by a mobile logistic element tailored for each task force.

b. For the purposes of northern operations, direct support is

that support, over and above organic capabilities of a combat unit, which must be rendered in the immediate vicinity of the unit, to provide extended combat endurance in independent operations.

c. For the purposes of northern operations, general support includes all support other than direct support. In small, separate theaters, general support includes all administrative activities from the first echelon above the level of the basic combat formation through the equivalent of the communications zone structure.

59. The Small Northern Theater

a. In a small northern theater under combat conditions, the same requirement for force economy that limits combat force strength limits administrative resources. Organic combat service support forces usually are not sufficient to provide conventional support organization. The effort to follow conventional patterns of fixed depot complex and line of communication structures would lead in the small theater to a serious disproportion between combat and support strengths. To avoid such disproportion, economy in organization is promoted by functionalization. The most economical and responsive transport means are employed to reduce the requirement for storage at multiple locations. Maintenance is performed in place in so far as practicable and canibalization and washout procedures are exploited to reduce uneconomical long distance evacuation of equipment for maintenance.

b. The theater is organized with the fewest possible echelons of control. In the simplest configuration, which is typical for a small theater, a distinct communications zone is not organized. The combat service support organization consists of the mobile direct support elements supporting task forces and a general support organization which provides:

(1) Combat service support to task forces and other units located within their areas of responsibility.
(2) General transportation services including transportation movements management, and when available, line-haul motor, rail, and inland waterway transport, cross-country bulk carriers, logistic air transport, including Army air transport, mode transfer points, and surface and air terminals.
(3) Supply handling areas generally in the vicinity of ports.
(4) A combat service support headquarters directly under the theater Army commander.

c. The theater support organization includes functionalized supply, maintenance, and service headquarters:

(1) The theater support headquarters:
   (*a*) Exercises tactical and technical control over assigned and attached combat service and combat units.
   (*b*) Provides the theater Army logistic organization which, in addition to other functions, plans for and participates in joint and combined logistic operations at the joint and combined command levels.
   (*c*) Maintains central theater logistic records by mobile ADPS systems and maintains logistic communications with CONUS or supporting major oversea command by electronic data links.
   (*d*) Performs civil affairs functions within the theater Army area, except those functions performed by tactical unit commanders within their areas of combat operations.

(2) The theater support organization establishes supply handling areas in the vicinity of ports and establishes the minimum necessary number of area general support complexes, each complex consisting of supply storage and issue, maintenance, medical, and other essential services. Storage is planned so that the loss of any one area to nuclear attack will not result in loss of total stocks of any critical commodity.

(3) A distinct communications zone is not organized and supply areas and dumps are not echeloned from the rear forward in the conventional manner. Storage and transportation of Class V, except special ammunition, are integrated into the established general supply system. Responsive transport is exploited to assure effective supply support without the conventional echeloned supply system.

(4) The theater support organization establishes and provides general transportation services for movement of supplies and personnel and for medical evacuation.

(5) Since the combat and support forces are widely separated within the theater, the theater Army controls only those areas which are actually occupied by friendly forces. Intervening spaces are uncontrolled and must be regarded as accessible to enemy elements. The combat service support organization is responsible for security of its own elements, including line of communication elements, moving through uncontrolled ground space and in addition may be assigned responsibility for counterguerrilla operations. Separate battalions are assigned to the theater support organization for these functions.

(6) Due consideration for protection of logistic elements from enemy air attack must be reflected in air defense planning. Local air defense capabilities are included in handling areas in the vicinity of ports and establishes the organizations of area general support organizations.

d. The small northern theater normally involves air and naval elements as well as ground components. The ground force combat service support headquarters participates in joint planning and support of joint operations and usually is responsible for provision of certain common service and cross-service support to the other components.

e. The requirements for performance of the full range of theater combat service support functions and joint staff and support functions with a small staff and limited resources place on the combat service support headquarters unusually severe demands for ingenuity, effectiveness, and economy of effort. Combat service support of the small separate theater is one of the most difficult of Army support problems.

60. Direct Support

a. When battalions and brigades operate under division control in conventional formations, direct support is provided by division mobile support centers, providing support to brigades and other assigned or attached divisional units in the vicinity. The mobile support center is a task grouping of selected supply, service, and maintenance elements operating under the control of the support command commander.

b. When brigade and battalion task forces operate independently, under area command control, direct support is provided by mobile direct support elements. Mobile direct support elements are comparable with division mobile support centers, but have complete cross-country mobility and the capability to sustain combat operations of supported forces for at least three days without resupply support. The function of the direct support element is to furnish close and continuous logistic support to the task force. The composition of the direct support element varies according to the type of unit supported and its peculiarities in equipment. Normally, a direct support element consists of a maintenance section which provides repair service for vehicles, weapons, heavy equipment, electronics, and technical inspection of quartermaster items. A supply section handles rations, POL, and ammunition with some Class II and IV. A service section provides bath, PX, laundry, and graves registration. An engineer section provides limited engineer construction. A medical clearing platoon processes casualties and provides emergency dental care. The

headquarters section includes command and control, movement control, communications platoon, MP section, and a transportation element for cargo haul.

61. General Support

a. General support functions in support of brigade forces are performed by the division or, when task forces are operating independently, on an area basis under the headquarters exercising area command.

b. General support activities in support of cross-country operations are established at points accessible to line haul transportation. Line haul transportation may be provided by rail, highway, inland waterway, logistic air, and cross-country trains.

c. General support activities are organized under general support organizations. These organizations include supply, maintenance, and service elements of the technical services, and medical evacuation and hospitalization capabilities; hold sufficient stockages to support the projected operations, with due consideration to local replenishment cycles, time and distance factors, and seasonal resupply considerations; have the capability to operate lines of communication to direct support elements cross-country and by Army air; and have the capability to defend themselves against guerrilla attack.

62. Selection and Layout of Support Organization Sites

a. The site selected for location of the support organization should be one that facilitates logistical support by road, air, water, and rail, where available. If not available, cross-country means of transportation should be used. The site should also be conveniently near the units which will be supported. Cities and villages in the northern region may be so located or afford such housing facilities as to warrant their selection. Consideration should be given to the use of such existing structures to decrease tonnage and construction time. The following additional factors are considered in the location of a support organization:

(1) *Proximity to a stream or lake.* Many streams and deep lakes remain open even in extremely low temperatures, and, when frozen, their ice yields more water than snow per unit volume. Avoid locating sites on flat ground in the immediate vicinity of northern streams as their courses frequently change and seasonal floods are common.

(2) *Proximity to local source of fuel for heating purposes.*

(3) *Downwind side of hills and part way up the slope.* Cold air flows to the bottom of valleys in calm weather. The

area selected must be free of danger from avalanches.

(4) *Terrain which lends itself to defense.*

(5) *Good soil conditions (rock, sand, or gravel) to minimize unfavorable effects of permafrost.*

(6) *Timbered areas.* Timber affords concealment and wind break and may be used as a source of fuel, material for construction, and bedding.

(7) Proximity to fixed communications facilities for entrance to long distance communications service.

(8) Area of sufficient size to allow proper dispersion.

(9) Proximity to terrain suitable for establishment of an all season airstrip.

b. The loop system is used for the layout of the site to provide turn arounds and prevent congestion along the MSR. An advance party with engineer support should be sent forward to prepare the area prior to displacement. When preparing the area, consideration should be given to the location of installations. The most active installations should be located near the entrance of the site to reduce the amount of through traffic.

Section IV. MATERIEL AND SERVICES

63. Levels

a. At general support activities, supporting independent task forces on an area basis, stocks are maintained at levels sufficient to assure continued support in the event of interruption of line haul transportation. Generally, seven to ten days stocks are maintained at general support organizations. These need not be kept at one place but should be dispersed in consonance with security and projected deployment of supported forces.

b. Direct support element stockage includes from one to two days supply of class I for the supported force, in addition to the basic load for direct support elements; not less than one day of class III; and one or more days of class V for the supported force.

(1) Up to approximately three days of supply of selected fast-moving class II items are held by the direct support element.

(2) Repair parts are held by maintenance elements on the basis of stockage lists established by experience, with due consideration for the nature of the operations supported, weather conditions, the degree of mobility of supported and supporting elements, and order and shipping time from general support elements. Minimum stocks of major assemblies are held by direct support maintenance elements. To avoid increasing the mainte-

nance unit load so far as to reduce mobility, primary reliance for supply of major assemblies is placed on rapid release and movement of these items from the general support organization.

(3) In establishing the class III day of supply, consideration is given to the greatly increased POL consumption in northern winter operations which results from the requirement for space heating, warmup of equipment, and the greater distances traveled by all elements in dispersed operations.

(4) Limited maintenance float quantities of major items are held at the direct support element.

(5) Construction materials and bridging are held at the direct support element only if there is the prospect of an early requirement. Such materials are brought forward from the general support organization when the need for them is apparent. Care is exercised to avoid bringing up class IV items without firm plans for employment and thereby wasting transport and exposing valuable assets to loss.

64. Storage

a. During summer seasons, well-drained ground is selected for storage sites.

b. Winter storage.

(1) All supplies stored in the open should be stacked on pallets or dunnage to prevent freezing to the ground. Stacks should be located to minimize the effects of drifting snow.

(2) CONEX containers may be used for rations requiring protection from weather but not requiring heated storage.

(3) Nonperishable rations may be stored without heat during the winter but at interseasonable periods may be damaged by repeated freezing and thawing (TM 743–200–1).

(4) Liquids not subject to damage by freezing are packaged in metal or plastic containers.

(5) Medical supplies, special fuzes, batteries, and other items subject to damage by freezing are stocked in heated shelter, for which purpose tentage warmed by high BTU blower type heaters may be employed.

(6) Gasoline and diesel fuel may be stored in flexible containers at low temperatures, although the containers cannot be moved easily and are subject to damage from

handling at temperatures below minus 30° F.

c. Mobile direct support stocks, including class V, are held on mobile storage vehicles. Nonpowered cross-country trailers are desirable for bulky and heavy items. Stocks, including spare parts, may be transported on trailers in CONEX containers, which afford good environmental protection. Class I and class V stocks are unitized on pallets and the mobile direct support element is provided with tracked fork-lifts to facilitate handling of unitized and containerized supplies. Mobile direct support class III stocks are held in rolling liquid transporters and flexible tankage in so far as possible. POL may also be stored and distributed in 600-gallon skid-mounted tanks equipped with powered or hand pumps. Drums are used only when more efficient methods are not available. Resupply movements of heavy tonnage commodities are managed between the general support and direct support activities so as to take maximum advantage of in-transit loads for backup stocks instead of tieing up transport and supplies in static on-vehicle loads at the direct support element.

65. Distribution

a. When the battle area consists of several areas controlled by independent combat elements, operating with little or no mutual support, the zones between these controlled areas are uncontrolled and must be regarded as equally accessible to friendly and enemy elements. Accordingly, the normal echeloning of supply points is infeasible for support of independent task forces in northern operations. Stocks must be held at a general support supply point or in mobile storage by the general support organization.

b. Unit distribution is the preferred method for all deliveries from general support to direct support elements and, insofar as practicable, from direct support elements to trains of supported battalions. Air delivery direct from general support organization to using unit, bypassing direct support elements and battalion trains, is often practicable and in such cases is economical of time and effort.

c. The distribution system utilizes all available means of transport for essential movements. Loads are consolidated for forward movement. Loaded vehicles are routed through to the farthest forward breakdown point. As far as practical, loaded vehicles and containers are exchanged for empties at the point of use and empties are moved to the rear by the earliest available transport. Prompt return of empty containers, with particular emphasis on rolling liquid transporters, is essential to prevent interruption of the distribution operation; a continuing forward flow of containers, without effective return of empties, must soon exhaust

resupply capabilities. When part of the MSR utilizes roads on which wheeled vehicles are employed, rendezvous points are established for transport of loads from wheeled to tracked transport. To reduce labor at the transfer point and throughout the distribution system, supplies are palletized or containerized and held in unitized packages as far forward as possible. Cross-country materials handling equipment (MHE) capable of handling unitized loads is provided to the task force. Emergency resupply deliveries to the task force and medical evacuation from direct support element clearing stations is accomplished by Army aircraft controlled by the general support organization. All transport capabilities are centrally coordinated within the general support organization and the independent task force.

66. Maintenance

a. Maintenance in northern areas consumes a high proportion of the total effort of any force. Maintenance must receive command effort. Factors tending to increase maintenance requirements include the long distances over which operations are conducted; the heavy strain of cross-country movement on all equipment; the lack of railroads which throws a major part of the line of communication task on vehicular transport; the breakdown of organizational maintenance under conditions of extreme cold and extended darkness; the need for increased quantities and additional types of equipment to provide environmental protection and cross-country mobility; and the general effect of environmental factors in making all activities slower and more difficult. The significance and magnitude of the maintenance task make of the highest importance all measures for reduction of maintenance requirements and facilitation of maintenance activities.

b. Organizational Maintenance

(1) The difficulty in carrying out physical activities in cold weather demands continuing emphasis on the performace of organizational maintenance. Organizational maintenance failure is the direct cause of a large part of the increased field maintenance requirements associated with northern operations. Failure to accomplish organizational maintenance throws an additional burden on field maintenance capabilities, which jeopardizes accomplishment of the field maintenance mission and with it the mission of the supported force. It is impossible to provide enough field maintenance support to make up for uncorrected and cumulative deficiencies in the organizational maintenance area.

(2) To ensure proper performance of organizational mainte-

nance, competent training and constant command supervision are essential. Training literature is adequate but must be used. Matters for emphasis include cold weather starting and warmup, availability and use of proper lubricants, and gear selection.

(3) Vigorous supervision of organizational maintenance is one of the most effective means available to the combat commander to ensure sustained operational effectiveness of his unit.

c. Field maintenance emphasizes on-site repair by maintenance contact teams. Maintenance contact teams must be equipped with light cross-country vehicles and portable heaters. Cannibalization may be authorized to reduce the number of items evacuated from the task force and to keep the maximum possible number of items operational. It is generally infeasible to carry much maintenance float equipment at the direct support level, although a small number of communications items may be an exception to this rule. Primary emphasis is placed on keeping authorized equipment operational, with resort to maintenance float items held by the general support organization only in case of complete loss of an operational item.

d. Aviation maintenance is performed at each echelon. The general support organization provides contact teams for spot repairs in forward areas as necessary.

e. TM 9–207, lists detailed information on lubrication, operation, and maintenance techniques.

Section V. MEDICAL EVACUATION AND HOSPITALIZATION

67. General

This section is not intended to duplicate information currently in other Field Manuals. Only areas of specific interest when operating in northern latitudes are included.

68. Evacuation

a. The task force operating in northern latitudes should establish a relatively short holding period. However, the adverse environmental conditions under which the Medical Service functions makes it exceedingly difficult to provide extensive definitive care over an extended period. An evacuation policy of 15 days is recommended subject to change by the Surgeon as the tactical situation dictates.

b. The general nature of the arctic terrain makes surface evacuation of patients difficult in winter and virtually impossible in summer. The frozen tundra and permafrost form an exceedingly

rough roadbed which makes patient evacuation slow. In summer, the tundra becomes marshy, streams vary from mere trickles to large torrents, and operation of ambulances off the existing road network is often impossible. The lack of adequate roadnets and the military necessity of moving supplies over the same route greatly restrict patient evacuation. Ambulances are required for movement of patients from hospitals to air fields and for patient evacuation when weather conditions do not permit air evacuation.

c. The most practical means of patient evacuation is by helicopter. Ideally, the task force surgeon should be furnished helicopters for primary evacuation. For evacuation outside of the task force area, air evacuation out of the theater is again the primary means. Aircraft, resupplying the task force can be used carry patients on the return trip.

69. Hospitalization

Method of determining bed requirements for the task force is basically as appears in FM 8–55. Hospitals should be considered fully occupied when they reach 60 percent of their capacity. This allows space for additional patients should the weather condition make air evacuation to the Zone of the Interior impossible for an extended period. Hospital units should be capable of performing definitive treatment even though a relatively short evacuation policy is in effect. Such definitive treatment should be dictated by the gravity of injury or disease, and should be of such extent as to be supportive to the immediate emergency and to successful evacuation. The hospital unit should never sacrifice beds otherwise available, by engaging in a program of definitive care that could as well be done farther to the rear.

Section VI. TRAFFIC CONTROL

70. General

a. Conditions. Road nets are limited, existing roads frequently provide for only one way traffic, and road conditions are normally hazardous during winter months due to ice and snow cover. Visibility is seriously affected by snowfall, snow drifts, frequent ice fog, and long hours of darkness which extend the operation of vehicles under blackout conditions.

b. Traffic control operations.

(1) Extensive use of wheeled vehicles by Military police on improvised roads and tracked vehicle trails is impractical. Military Police operating in such areas require a track vehicle capability.

(2) Reflectorized signs should be used extensively behind the light line and luminous signs forward of the light line.
(3) Rotary and fixed wing aircraft, if available, will provide essential mobility for control of traffic in expediting movement of units over the limited roads and trails. Rapid reconnaissance over routes in use can be achieved by use of aircraft. The frequency of route reconnaissance depends upon traffic density, weather, and type of vehicles on the road. The requirement for investigative and control personnel at serious accidents, incidents, and other emergencies demand minimum response time. This can be accomplished by rotary wing aircraft.
(4) Traffic control posts and check points requiring continuous operation in winter months may require the doubling of personnel. A "buddy" system should be established and shelter provided for traffic control personnel.

Section VII. PERSONNEL

71. General

Personnel functions and procedures are basically no different in northern operations.

72. Selection of Personnel

a. Physical and mental prerequisites are prime factors in selecting the individual for field operations.

b. In addition to the basic physical and mental prerequisites for the combat soldier, individuals should be free from the following physical defects or limitations:

(1) Circulatory diseases affecting the extremities.
(2) Skin grafts on the face.
(3) Inner ear difficulties.
(4) Previous history of severe cold injury.

Medical records should be screened and personnel affected by any of the above conditions should be rejected for assignment to northern latitudes. Individuals trained for, and to be assigned to, specific duties not involving frequent or prolonged exposure tc the elements may be treated as exceptions to the above.

c. Personnel who have displayed a degree of mental instability or lack of adaptability which is insufficiént to be considered as special cases elsewhere, frequently create much greater problems in northern areas. While limitations in this area are most difficult

to delineate, the factors exist and cause sufficient problems to warrant consideration and possible rejection.

73. Replacements

During winter months, environmental conditions demand that replacements be properly equipped and receive cold weather indoctrination prior to joining tactical units in the field. It is highly desirable that specialized training of replacements be conducted in an area that closely parallels northern conditions. Replacements should be given a period in which to become acclimatized prior to utilization under combat conditions.

74. Morale

a. Extremes in temperature, light, darkness, and long periods of isolation are factors which have a marked effect on morale in northern operations. Aggressive leadership at all levels is essential to surmount the obstacles which impede the provision of basic necessities required to maintain good morale.

b. The health of each soldier and confidence in his ability to meet the rigors of mountains, muskeg, and cold is related directly to his physical condition. The effect of physical fitness on morale cannot be overemphasized.

75. Discipline

a. Well-disciplined troops, properly trained, with an understanding of the mission can operate effectively throughout the year. Increased and unceasing supervision of individuals throughout the chain of command is mandatory during the winter months. First indications of malingering must evoke immediate corrective action from commanders or supervisory personnel at all levels. Weather and terrain encountered in northern operations may prevent the personal contact desired by a commander. Subordinate commanders are relied upon and the value of well-disciplined soldiers becomes increasingly significant.

b. Hard labor imposed in courts-martial sentences or extra duty given as punishment should insure a degree of work and cold weather exposure equivalent to front line combat units.

76. Prisoners of War

a. During winter months, a major problem in the evacuation of prisoners of war is their protection from extreme cold, particularly those captured without sufficient clothing and equipment for survival. Evacuation plans should be made accordingly.

b. Intelligence requirements may sometimes be of sufficient importance to consider the possibility of air evacuation in order

that timely information can be gained. Extremely strict in-flight security plans must be made.

c. It can be anticipated that relatively large numbers of prisoners will be taken at one time. In addition many troops will surrender because of deteriorating morale caused by a combination of factors such as ration shortage, sustained exposure to cold and other elements.

77. Headquarters Layout

The installation of a headquarters can present more than normal problems. Limited or non-existing roadnets, lack of built up areas, and the extreme difficulty in concealing major installations far removed from civilized areas are major factors. A more detailed reconnaissance is necessary and engineer support is required to enable physical occupation. A good deception plan, well executed, offers a greater measure of security than attempts to completely camouflage a major installation in undeveloped areas. The effects of terrain and limited roadnets, combined with the requirement for passive security measures may dictate a greater dispersal of activities within the installation.

CHAPTER 4

EMPLOYMENT OF THE ARMS AND SERVICES

Section I. INFANTRY

78. General

a. The role of infantry in northern operations remains essentially the same, although the technique of accomplishing a mission may vary considerably. Units are usually organized into highly mobile, self-sustained tactical groupings with only those weapons and equipment suited to the operation. The number of TOE weapons may be reduced for a specific operation to make sufficient resupply of ammunition possible. Efforts should be directed toward equipping these infantry units with suitable weapons with which to provide their own fire support.

b. The value of surprise is greatly increased in forested areas under conditions of cold and snow. Skillful use of weather conditions, such as fog or blowing snow, can be of great advantage. To insure success, plans for infantry operations must be made in detail and be made known to every individual before action is initiated.

79. Cover and Concealment

a. In the forested areas, troop movements are concealed by the trees. Cover from hostile fire may be constructed from existing timber, by digging emplacements, and the use of icecrete, snow, and ice. In open tundra areas, concealment may be gained by camouflage and by the use of deception. Fabricated bunkers may be used for additional protection.

b. In the treeless barren lands, few recognizable terrain features exist. Observation will, at times, be aided by the extreme clarity of the air. In the Arctic barren lands, the ground is permanently frozen except in some sand and gravel areas, raised beaches, or lakes and river banks. Even here, frost often lies within a few centimeters of the surface. Consequently, the siting, construction, and concealment of defense positions are more difficult than farther south. In winter, snow is normally the only

construction material, but fortunately deep hard-packed drifts are usually associated with tactical features. During summer, it will often be difficult to dig in because of permafrost and poor drainage, and may necessitate building up breastworks using peat, rocks, or surface gravel. Because of the difficulties of concealment, dispersion and deception must be practiced. During these periods, units must use caution in their movements, as the advantage will lie with the observer who can remain motionless.

80. Effect of Terrain on the Accomplishment of the Infantry Role

Terrain and climate combine to decrease mobility of infantry units. In summer, muskeg swamps and lakes form barriers which must be surmounted or bypassed. When frozen, lakes, swamps, and rivers may often be used as roads.

81. Effect of Cold on Infantry Weapons

a. In extreme cold, metal becomes brittle. Increased parts breakage occurs in all types of weapons.

b. Many weapons create ice fog which, on a still day, may obscure the gunners' vision; thus requiring movement to alternate positions or the use of a flank observer to direct the fire.

c. Mortars experience an increase in breakage of firing pins and cracking of baseplates. When ground mounted mortars are used, the base plates must be cushioned against the frozen ground by using sandbags or log cushions. Precautions must be taken to prevent the mortar mount from becoming frozen to the ground.

d. Experience firing data should be used for recoilless rifles and rocket launchers, and back blast areas must be increased to compensate for the slower burning propellant. Rocket launcher gunners must wear the face mask for protection from the flying particles of propellant.

82. Effect of Ice and Snow on Infantry Weapons

a. Infantry weapons will function under northern conditions when men have been trained in their proper maintenance, lubrication and use.

b. The main problem is to keep snow and ice out of the working parts, barrels, and sights. Special breech and muzzle covers should be provided and troops trained in their use. Special light lubrication is necessary because of the effect of cold on normal lubricants.

83. Environmental Effects on Infantry Operations

a. Infantry operations may become restricted because of limited

roads and lines of communication. Terrain is less accessible in all seasons than in temperate zones. Troops require more time to devote to problems of living and shelter during winter months. Efforts must be directed toward oversnow mobility. Infantry must not become road bound. The guiding principle in providing equipment for infantry should be to provide only the minimum amount consistent with the health of the troops and the success of the mission. Snowshoes or skis are necessary for individual movement; and sleds must be provided for each small group to carry tentage, stoves, fuel, and other equipment necessary for sustained combat.

b. In attaining individual mobility, the primary consideration is how much a man can leave behind without impairing his capability as a combat soldier. Pack loads above 40 pounds should be avoided for long marches, even among seasoned troops. Only ammunition and indispensable items, including light weight rations, should be carried. Items not necessary for fighting or survival are transported in unit trains.

c. The requirement for movement being paramount to other considerations, weight carrying capabilities are not wasted on non-essentials, even in weapons and ammunition. Because of the dampening effect of deep snow or mud, impact bursts of artillery and mortars are less effective. Mines often fail to explode when stepped on or when driven over by tanks. The use of such weapons, accordingly, is weighed carefully and in the light of the specific requirements of each operation. Direct fire weapons are often preferable to indirect fire weapons. A plentiful supply of ammunition for a few weapons is more desirable than a wide variety of weapons with little ammunition.

84. Tactical Considerations (Detailed Operations are covered in Ch. II — Operations)

a. The situation will dictate the tactical composition of the forces. The factors of METT (mission, enemy, terrain and weather, troops) and fire support available, govern the tailoring of task forces. The attachment and detachment of units is ideally suited for northern operations. The use of tank and mechanized units gives opportunities for envelopment and deep penetration. The use of infantry units for deep penetrations by air lift gives the commander greater flexibility in the formulation of his operational plans.

b. Mechanized infantry units with their organic carriers have the capability of movement over difficult terrain. The carriers have the capability of transporting the units within assaulting distance of hostile forces. In addition, the troops' equipment may

be transported on the carriers, thus relieving the troops from the fatiguing problems of transporting their equipment.

Section II. ARMOR UNITS

85. The Role of Armor Units

a. The mission of armor units in northern latitudes, as elsewhere, is to attack, disrupt, and destroy enemy forces by fire, maneuver, and shock effect. Maneuver and shock effect are limited by deep snow and extreme cold in winter and by the vast areas of muskeg in the summer. Firepower and shock effect of tanks against unprotected personnel is as demoralizing in the areas of northern operations as in any other area.

b. Terrain and trafficability studies are paramount to tank employment since trafficability is a problem.

c. Employment of tanks in elements of platoons, companies, and battalions as part of a combined arms task force is desirable.

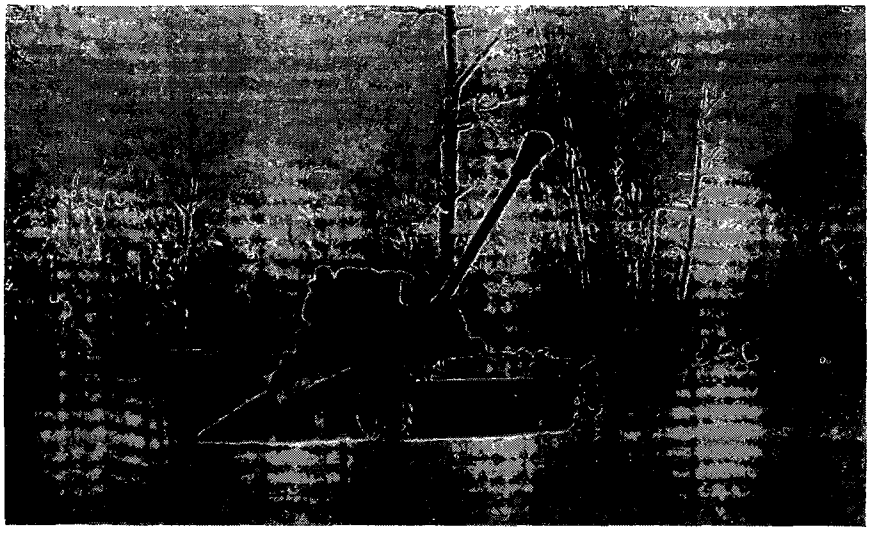


Figure 16. Tank operating in 75 cm of snow.

86. Effects of Deep Snow

a. It is impractical to establish definite rules for oversnow operations due to the varied snow conditions encountered. Since experience in each particular area is necessary to accurately predict snow trafficability, reconnaissance must be made for each separate action to determine current snow conditions. Most tracked vehicles are immobilized by 1 to 2 meters of wet snow. Heavy tracked vehicles may negotiate fine, dry snow of 1 to 2

meters in depth (fig. 16). Normal speeds may be maintained after a packed snow trail has been formed by the passage of several heavy vehicles. The surface of a packed snow trail becomes compacted into a hard mass resembling well-packed wet sand and is easily traversed by all types of vehicles. In the event of a thaw, proper driving techniques must be used to prevent vehicles from tracking and eventually becoming mired. Freezeups frequently follow thaws, and produce glare ice which makes roads practically impassable to tracked vehicles, particularly on slopes of 35 percent or greater. Again, proper driving techniques must be emphasized as it is desirable that all vehicles track the lead vehicle on glare ice. Tracklaying vehicles operating in the north should be equipped with all steel chevron tracks for all season cross-country operations.

b. Dry snow causes few operating difficulties as it has little tendency to pack on suspension systems. Wet clinging snow has a tendency to accumulate on the track, suspension idler wheels, and sprockets (fig. 17), and may require occasional halts for removal.

87. Ice Crossing

Lakes and streams may be crossed on the ice during the winter months if ice is of sufficient thickness and reasonable precaution is exercised. Crossing sites must be inspected for cracks, pressure ridges, and thin spots prior to placing vehicles on the ice (table II).

88. During Spring Breakup

a. Vehicles mired in deep frozen mud or ice require special recovery techniques. Tanks should be parked on high dry ground, unthawed snow, or on brush or logs to prevent freezing-in. During the breakup as the active frost layer begins to melt the ground becomes soft and marshy. Although traction is poor, operation is possible during this period if tanks can penetrate the mud and find footing on the frost layer below (fig. 18). As the season progresses, the active layer thaws and vehicles sink deeper into the muck, may "belly down" and become immobile. To provide greater mobility under these conditions, vehicles should not follow in the same tracks of preceding vehicles. Movement is possible in areas where permafrost is still near the surface, i.e., on the shaded side of woods, on ground with a good moss cover, and on the shaded slopes of hills. Even when the valleys have become impassable, limited operation may still be possible on crests where drainage is best.

b. Extreme caution is necessary in crossing large streams and lakes late in the season.

Figure 17. Wet snow in tank tracks.

89. During Freezeup

Conditions during the early freezeup are much the same as those which occur in the spring. The ground thaws in the daytime and freezes at night. When the frost comes to the surface and the ground is completely frozen, a period of high mobility for the tank is experienced. The frozen ground offers good footing, and the shallow snow does not effectively reduce the speed of the tank. Frozen ruts, especially during early fall, are a hazard. Stream and lake ice cannot be used for crossing; however, many can be forded by breaking through the thin ice. In areas with few streams, the late freezeup season offers the best opportunity for tank employment.

Figure 18. Tank operating on frozen undersurface.

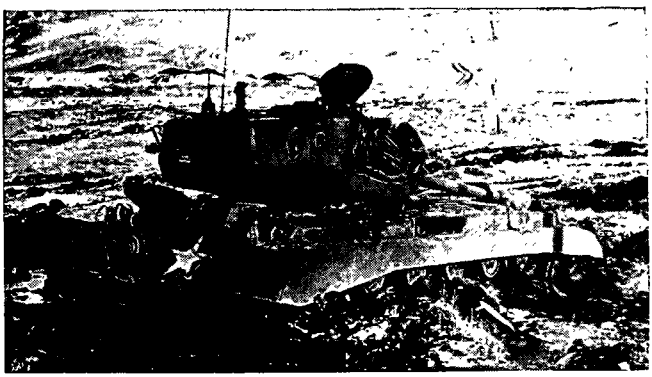


Figure 19. Tank mired in muskeg.

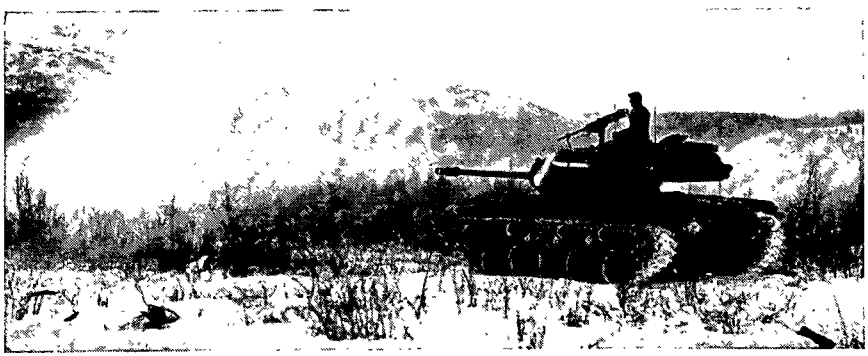


Figure 20. Ice fog around a 76-mm tank gun.

90. Summer Movement

a. In summer, much of the northern terrain is a soft mud-based marshland or muskeg, or is a swamp that is covered with a thin layer of moss and lichens. Once the moss layer is ruptured, the mud offers no support above the permafrost level. In some areas during summer, the frost layer recedes to a depth that limits tank operations. Floating bogs may also be encountered. These floating bogs are masses of thickly matted vegetation and rotting vegetable matter that float on pools of water. They are difficult to locate by normal inspection as they will usually support a man; however, they will often not support even the lightest vehicles. If a floating bog is suspected, a long prod pole should be used to determine where the bog lies. Muskeg should be avoided by careful reconnaissance and route selection. In some localities, muskeg is interspersed with large glacier boulders just below the surface. Damage to suspension systems and tracks is highly probable during operations in such terrain.

b. When it becomes necessary to cross open muskeg, vehicles should not follow in the same track. In very soft spots, each vehicle should make its own track. No abrupt turns should be attempted (fig. 19). Recovery in muskeg is exceptionally difficult because tanks "belly down" and tracks do not regain the surface. It is frequently necessary to winch the tank to a spot where the muskeg is solid enough for the tracks to regain the surface before recovery can be completed. Seldom can recovery be accomplished with less than two vehicles.

91. Preparation for Winter Operations

The commander is responsible for insuring that tanks and other equipment are completely winterized prior to the advent of cold weather. Failure to winterize tanks will render them inoperative in extreme cold. Winterization of equipment should be undertaken on a priority basis. Units embarking for the north during the winter months should have all winterization completed prior to departure in order to be operational immediately upon arrival. Tank crews should be provided with snowshoes, tents, and heating equipment.

92. Observation of Fire

a. Visibility in the north, as it affects tank gunnery, presents many problems. The formation of ice fog, blowing snow, snowfall in driving winds, and snow blown up by muzzle blast all reduce visibility. Soft snow blown by the muzzle blast will probably exist under any condition where light dry snow is on the

ground. The burning propellant (fig. 20) will create ice fog. The explosion of a high explosive shell will create a similar condition in the target area. Masses of dry snow are also blown into the air by the burst. First round hits assume even greater importance. When these conditions cause the gunner's vision to be obscured, observation from another tank may be the quickest means of adjusting fire. The tank commander, because of his elevated position and the availability of magnifying sights and field glasses, has much better visibility and depth perception on snowcovered terrain than have troops on the ground.

b. Extreme cold has a definite effect on muzzle velocity and hence the accuracy of tank ammunition. Corrections for firing table data and for ballistic computer setting must be furnished by ordnance for types of ammunition issued in the northern latitudes.

If these corrections are not furnished, then using units must determine them by actual firing.

93. Handling of Tank Ammunition

Certain difficulties in handling ammunition are present. The binding tape around the fiber carton is difficult to remove while wearing mittens; ammunition cannot be touched with the bare hands without danger of metal burns. Ammunition tends to freeze in the wooden fuze protective ring, making it sometimes necessary to cut ammunition from the fiber cases. Cold ammunition placed in the warm interior of a tank will "grow" frost crystals if the tank interior is even slightly warmer than the outer air. These crystals increase the difficulties of ammunition handling. Ammunition racks are difficult to operate while wearing mittens; however, operation is expedited by the use of leather thongs or extensions on rack latches and other handles.

94. Operations in Extreme Cold

a. Crew Comfort. Tank crews are more crowded and entry and exit through hatches is made more difficult by heavy clothing necessary for northern operations. Confined crew positions in tanks cause parts of the body to become cramped, thereby restricting circulation. In these confined positions, clothing is drawn tight or becomes compressed and loses its insulation value. The drivers and commanders are subject to increased windchill as they are frequently required to ride with their heads outside the hatches and are exposed to the wind generated by the movement of the tank. Constant supervision is necessary to insure against frostbite. Halts, regulated to fit the situation, must be provided to rotate crew positions, restore circulation, and warm body parts

chilled by loss of insulation. Windbreaks should be used during movement in extreme cold to reduce the windchill factor.

b. Tank Operations. After the tank engine is started and warmed up, the tank should move out slowly. The power train should be broken loose gently to prevent failures due to sudden shock. Sharp turns should be avoided until the transmissions and differentials have had time to warm up. Initial movement should be restricted to low gear operations for some distance until final drives, wheel bearings, and support rollers have become free. At each halt, packed snow should be removed from the suspension and drive sprocket to prevent track throwing.

c. Avoid Exploring. Avoid driving in deep snow, snowdrifts, or on ice unless the route is prescribed or the mission requires it. Plunging through woods is dangerous as tops of frozen trees may break off and fall straight down on the tank. If necessary, trees should be pushed down slowly and cautiously with the tank hatches closed.

d. Carbon Monoxide. Crews must remain constantly alert for carbon monoxide. Open flame heaters or engine exhaust must not be used to heat closed areas.

e. Vehicles Starting.

(1) Vehicles should not be allowed to become cold soaked. Engines should be started periodically to keep lubricants and engines warm.

(2) Frozen power trains and engines of extremely cold vehicles are easily damaged by towing in an attempt to start the vehicle. In many cases, it is impossible to start track vehicles by towing because the suspension and final drives are so cold that the tracks will not rotate. Extreme care must be used in towing or pushing to insure that no sudden shocks are applied. Metal is very brittle in the cold; and tow cables, final drives, or push bars may fail under shock loads. However, an engine may be started by towing if no other means of starting is possible.

95. Maintenance in Extreme Cold

a. Maintenance Difficulties. Maintenance of mechanical equipment in extreme cold is exceptionally difficult in the field. Shop maintenance time is also increased as equipment must be allowed to thaw out and warm up before repair can be accomplished. Extreme care must be exercised in performing maintenance in extreme cold as bare hands will stick to cold metal. Also, fuel in

contact with the hands will result in supercooling due to evaporation, and hands can be painfully frozen in a matter of minutes. For detailed maintenance instructions see TM 9–207.

b. Time Required to Perform Maintenance. At temperatures below —40° F., as much as five times the normal maintenance time may be required. Starting and warmup time is also increased, and may approach 2 hours in temperatures of—50° F. Complete winterization, diligent maintenance, and well-trained tank crews are necessary in winter operations. The degree to which cold affects operation can be stated in three general temperature ranges.

(1) Down to —10° F., operation is not difficult, but resembles operation in the northern portion of the United States during the hardest winters.

(2) From —10° F. to —40° F., operations are more difficult. At the warm end of the range, lack of winterization will result in only a slight loss in efficiency; at the bottom of the range, lack of winterization and training will result in many failures.

(3) Below —40° F., operations become increasingly difficult; at temperatures in the vicinity of —60° F., the maximum efforts of well trained men are required to perform even a simple task with completely winterized material.

c. Maintenance Shelters. Performance of field maintenance at temperatures below 25° F., is extremely difficult unless some type of heated shelter is provided. Maintenance shelter tents, portable shelters, or large tarps and air duct heaters are necessary whenever tanks are operated in the northern latitudes.

Section III. ARTILLERY

96. General

a. Artillery fire support will be provided in northern operations as in other areas. However, artillery units will find that problems of maintenance, mobility, resupply, observation, survey, and communications are intensified.

b. (1) The rugged and inaccessible nature of arctic terrain requires the use of self-propelled and air mobile artillery. Normally, a light artillery battalion (SP or airmobile) will be attached to an infantry brigade employed as a task force. The attachment of medium or heavy artillery or airmobile missiles or rockets may be employed for additional fire power and a nuclear capability.

(2) Glacier and mountain operations may require the employment of air mobile artillery. Units assigned such a support mission may be equipped with supplementary weapons in order to accomplish the task. Personnel must be thoroughly trained in the techniques of loading and lashing, rigging, and palletizing and in air mobile tactics. TOEs must reflect the special equipment necessary to load, transport, and support the firing units.

c. The artillery of the task force in the north must be prepared to assume functions, such as counter-battery, normally performed by a higher headquarters.

d. TOEs must be augmented with arctic operational equipment as necessary. If it is to be used in winter operations, all equipment should be winterized prior to its arrival in the theater.

e. Training at battery level and battery level control of firing should be emphasized. Prior field training for northern operations should be accomplished whenever possible. Special emphasis must be placed on the problem areas inherent during cold weather operations. Personnel must also be thoroughly indoctrinated in the use of arctic field expedients for both summer and winter use.

97. Movement

a. Successful movement is accomplished as a result of careful, detailed, and comprehensive route reconnaissance. Extensive reconaissance, both air and ground, should be carefully considered in great detail prior to any operation.

b. (1) Winter is the best time of the year for cross-country movement in the Arctic. However, problems are often encountered in crossing certain rivers and muskeg areas which do not freeze even at temperatures of 45°–50° below zero. Since most artillery self-propelled vehicles are limited to a 112 cm fording depth, it is mandatory that ice depth be determined prior to crossing frozen lakes and rivers. For load-bearing capacities of ice, see the appropriate table in this manual.

(2) During the summer months, movement across the extensive arctic muskeg is severely restricted. Engineer support must be relied upon.

c. The problem of determination of location and orientation while moving is increased due to the limited map coverage and difficult terrain. In many cases, vehicles column movement can only be oriented by the column commander dismounting and determining direction with a compass. Artillery weapons used in air mobile operations require tracked prime movers for link-up operations and further commitment.

d. It is essential that wheeled vehicles assigned to the maintenance, survey, reconnaissance, and communications elements be replaced by tracked vehicles to afford the cross-country capability necessary in this area of practically nonexistent road networks.

e. The artillery must have the same mobility as the supported unit. This includes appropriate tracked vehicle transportation and proficiency in the use of snowshoes and skis, particularly for the forward observers and liaison personnel. Army aircraft can assist in maintaining direction, determining locations, reconnaissance, communications, and observation of fire.

f. During winter movement in the arctic, protection must be given to personnel traveling in vehicles and for those remaining with disabled vehicles. Face masks and protective clothing for all drivers and assistant drivers not in heated cabs are mandatory. Vehicular heaters, both engine and personnel, must be carefully maintained. Loading plans should reflect the presence of equipment such as tents, stoves, etc., on each vehicle.

g. Since artillery is faced with large bulk and weight resupply problems, maximum use of aerial resupply should be planned. Continuous exploitation of the tracked vehicle capability for resupply purposes is necessary to insure the accomplishment of the mission. Rolling liquid transporters towed by tracked vehicles, assist greatly in furnishing the required fuel resupply.

h. Constant and energetic emphasis on motor and vehicular maintenance is required. The abnormal effects of low temperature upon vehicle motors and equipment becomes a matter of prime concern. Aggressive leadership and command supervision is essential to insure operation and movement.

98. Position Areas

a. Positions should be chosen primarily for tactical employment. However, consideration should be given to locations affording protection from the elements. Areas should be prepared prior to occupation whenever possible. Parapets and gun positions often must be built up with snow and available brush and wood rather than being dug in. Effective and continuous operation requires the establishment of warming tents or shelters within the position area.

b. Camouflage is difficult but not impossible. Maximum use should be made of camouflage paint and available terrain features. Units should be dispersed and camouflage discipline constantly enforced. The operation of vehicles, personnel heaters, stoves and the firing of weapons causes ice fog which discloses unit locations. Periodic displacement to alternate positions should be accomplished whenever practicable.

99. Observation

a. During winter months, good observation is limited to a few hours each day because of the short periods of daylight. Observation will also be limited during periods of fog, ice fog, snowstorms, and blowing snow. Snow cover reduces depth perception and obscures ground features and landmarks. Amber filters for observing instruments are required to reduce eye strain and personnel operating these instruments should be relieved frequently.

b. Bursts are difficult to observe on snow covered terrain and in muskeg due to the dampening effect. Preliminary adjustment by airbursts or use of colored smoke may be required.

c. Difficulty in determination of location will require use of expedients to bring initial fire into the target area. Observers will often be required to navigate by dead reckoning for orientation and for locating targets. The use of polar coordinates to locate the target is common. The marking of center of sector and the firing of airbursts may be required for the observer to locate the rounds when exact locations are unknown. Safety of friendly troops must be carefully considered at these times.

d. The use of aircraft for observation should be exploited to the maximum. Light aircraft should be assigned or attached to the artillery for observation purposes. Such aircraft can also assist in establishing communication relays, reconnaissance for routes and positions, identification of objectives, and for orienting ground troops in addition to adjusting artillery fires.

e. Observers must be equipped to move with the supported elements. Special consideration should be given to the radio equipment to be used by the observers. The weight of radios, batteries, and other equipment becomes critical if the observers are required to use skis or snowshoes as a means of transportation while attached to the infantry elements.

100. Survey and Metro

a. Traverse type survey is impractical over extended distances. Instrument fog-up and other mechanical failures are experienced. Recording and computing under winter weather conditions are extremely difficult. Survey control and adequate maps are seldom available. Grid azimuths may be determined by astronomic observation or by using a gyroscopic direction determining instrument. Starting coordinates will often have to be assumed. Triangulation is usually more feasible than traverse.

b. Use of helicopters to transport survey parties to inaccessible locations and to mark stations for triangulation may be necessary.

c. Electronic distance measuring devices are the most practical means of carrying arctic survey over extended distances.

d. As meterological data is a requirement, metro sections should be equipped with tracked vehicles in order to accompany the forward elements during task force operations. Metro section operations pertaining to the collection of data differ very slightly from those experienced in other areas.

101. Delivery of Fire

a. Normal fire direction procedures and techniques are valid during northern operations. Certain procedures must be emphasized because they are encountered more frequently in the north than in temperate zones. Due to increased communications difficulties, extended areas, and separate task force operations, individual firing batteries will be required to control their own fires more frequently than in other areas.

b. In most areas, survey control will be scarce or unavailable, therefore, it is often necessary to fire from an observed firing chart.

c. Due to poor visibility, shortened daylight hours in the winter, ice fog, dense brush, and wooded areas, high burst registrations are common. In the situation where survey control is not available, an executive officer's high burst may be required. Units may be required to register by establishing a base and firing high burst registrations from the howitzer positions.

d. Extreme cold weather will effect the ballistic characteristics of the weapons and ammunition. K factors of 100 meters per 1,000 meters of range are not uncommon. Great care must be taken when firing the initial round to assure clearance of friendly positions. Whenever possible, metro plus VE techniques should be used. When a metro message is not available, known or estimated experience factors regarding range K should be utilized. If any doubt exists as to what range K can be expected, a high burst techniques may be utilized to determine the point of impact of the initial round.

e. Fire Direction Centers should be prepared to construct and use countermortar and counterbattery charts.

f. Special care should be taken when selecting fuzes. This will vary with the type of target area terrain. Deep snow and unfrozen muskeg will reduce the effect of impact bursts by as much as 80 percent. Fuze time and VT are particularly effective against personnel in the open. VT fuzes have a tendency to malfunction when temperatures are below 20° F. When possible, these fuzes should be warmed by placing them inside the gun carriages (SP),

prime movers, special warming tents, or shelters constructed from gun tarpaulins. Extreme low temperatures will also cause malfunctioning of illuminating rounds by the freezing of the parachute and its components. Warming of these rounds will greatly reduce this probability.

g. Chemical munitions are adversely affected by deep snow, The canisters from base ejection shells may be smothered in the snow. Phosphorous shells, although producing the desired smoke, contaminate the area of impact with phosphorous particles which remain buried in the snow.

102. Communications

a. Wire and radio nets used in temperate zones are valid in the north and require no expansion. Due to difficulty of laying and maintaining extensive wire lines, radio is normally used as the primary means of communications. However, this does not imply that there should be any relaxation in the attempt to establish wire nets in the shortest time possible in order to back up the existing means of communication. If available, an internal radio-wire integration system should be established. The utilization of track-mounted VHF equipment will reduce the serious communication problems faced by the artillery.

b. Since cold weather reduces the battery life and the operating range of the small man-carried forward observer portable radios, a requirement often exists for a relay between the firing elements and the FO's. Use of Army aircraft should be exploited for this purpose.

c. Communication problems encountered in northern operations and their solutions are discussed in detail in Chapter 5.

103. Naval Gunfire

Naval gunfire may be available as an additional fire support means during amphibious operations or to reinforce artillery fires during coastal operations.

104. Air Defense Artillery

a. Air defense artillery missions in northern areas are the same as those in other terrain, subject to modification of techniques caused by climate, terrain, and nature of the operations. Lack of roads may reduce mobility and make resupply operations more difficult. Extremely cold weather causes longer warmup times for electronic equipment, use of special heating devices for ready missiles, and, in air defense missile units, may require launchers to be exercised at frequent intervals. Helicopter lift capabilities should be considered for resupply.

b. The types of air defense artillery units employed in northern operations are dictated by mission, terrain, and available transportation. TOEs often must be augmented to accomplish the assigned mission. Winterization and modification of equipment where necessary should be accomplished prior to entrance into a northern area.

c. Air defense artillery positions should be selected for their tactical utility and consideration of the logistical factors involved. Air defense missile units should, if possible, occupy previously prepared positions. Light air defense artillery weapons mounted on full track vehicles may occupy hastily prepared positions and effectively accomplish their mission. In adverse terrain, or under winter conditions, it may be difficult to dig in positions. Explosives may be used to expedite protection of the position, or parapets may be built up from logs or from ice and snow. Alternate positions should be chosen early and prepared as time permits.

d. Both friendly and enemy forces will use aviation to overcome lack of roads, strenghten signal communications, improve target acquisition, and to move and support small units. As forward area weapons units become available, they may be used to provide protection against aircraft at low or medium altitudes.

e. Surface-to-air missile units using nuclear warheads provide protection from any high altitude threat. Due to the electronic equipment for air defense artillery fire control systems, personnel must attain a high state of training to perform efficiently in the north. Heated shelters may be required for maintenance personnel to perform their duties. Generators, fire control equipment and launching equipment must be operated at frequent intervals under extreme weather conditions.

f. Commanders whose force includes air defense artillery missiles should not neglect the secondary ground support capability of these weapons. NIKE-HERCULES missile units also furnish a surface nuclear capability in addition to their primary air defense role.

Section IV. ARMY AVIATION

105. General

Army aviation missions do not change when operating in northern areas. The increased difficulties in surface transportation as opposed to the flexibility of air transportation will create increased demands for Army aviation support. Factors considered in support of tactical operations are the same as for normal operations, however, the effects of terrain and weather require the use of special equipment and modification of training programs. A summary of weather and terrain is covered in other portions of this manual. This section deals only with Army aviation operations as they differ from normal operations and in the application of special equipment and training.

106. Selection of Landing Sites

a. Airfields.

(1) During winter months the arctic terrain offers many landing fields for aircraft equipped with skis. Preparation of forward landing areas requires little effort; however, construction of permanent or deliberate areas is impracticable. Frozen lakes make excellent landing sites for both fixed and rotary wing aircraft. Except for use as a hasty airfield, packing or removal of snow may be necessary before lake surfaces are usable. Parking ramps should be cleared of snow and paths provided for movement of heaters and auxiliary power units if extended usage is anticipated. A ground reconnaissance should be performed to insure uniform ice thickness and absence of obstructions. Many lakes are subject to overflow from nearby streams, creating a mushy layer which can only be detected by means of ground reconnaissance. Aircraft equipped with floats can use lakes and streams for landing areas during summer months. Preparation of even temporary forward landing areas requires extensive engineer effort (fig. 21).

Figure 21. Landing strip.

(2) Muskeg and tundra afford suitable landing sites to ski equipped aircraft during the winter, with some engineer effort. A ground reconnaissance must be conducted to detect the presence of clumps of vegetation, rocks, and other hazards to landing. Movement of aircraft and ground handling of equipment is extremely difficult in these areas.

(3) Snow covered glaciers make suitable landing fields for ski equipped aircraft. Ground reconnaissance should be made prior to landing. Crevasses, often hidden by snow, constitute a threat to any movement on glaciated terrain.

(4) Determining the slope of potential landing sites in mountainous terrain is particularly difficult due to illusions projected by adjacent contours. In addition, depth perception is impaired in snow covered mountain areas. Circling or flying alongside the site will aid in overcoming these problems. Small trees or snowshoes or other material dropped from aircraft can provide visual references.

b. Helipads.

(1) Selection factors such as size, approaches and exits, takeoff and landing direction, and security are the same as for normal operations.

(2) Helicopter landing sites can be hastily prepared in winter by use of a drag or tracked vehicle to pack the snow. For helicopters equipped with skis or skid mounted pads, no surface preparation of snow is necessary.

(3) In mountainous terrain, it is often necessary to prepare landing sites by pioneer methods as stated in TM 5–251.

(4) Helicopter operations in muskeg and deep snow are hazardous because the basic design of landing gear offers no flotation.

(5) Wheel-through-skis or skid pads should be made available for northern operations during all seasons.

107. Weather Hazards

a. Visibility.

(1) Arctic weather conditions which frequently render flight impossible are—snow, clouds, fog, "white outs," and "gray outs."

(2) Blowing snow is a hazard in all hovering operations during winter months. It can be minimized by disturbing the surface and allowing it to refreeze. After refreezing, the snow will crust and form a hard surface.

(3) Ice fog may be found in the vicinity of populated areas

at low temperatures. Visibility in ice fog may be reduced to almost zero at ground level; however, ice fog does not usually rise above 30 meters. It can be self-induced by rotor systems and engine exhausts. Ice fog frequently takes from 15–30 minutes to dissipate after aircraft takeoff.

b. Turbulence. Some degree of turbulence is almost always present in mountain passes. This frequency reaches extremes which are prohibitive to flight.

c. Icing.

(1) Only those aircraft equipped with de-icing equipment are capable of safe instrument flight into clouds or visible moisture when temperature is freezing or below.

(2) Frost and ice covering on wing surfaces destroy aerodynamic efficiency of aircraft. Takeoff should not be attempted under any condition until frost and ice covering is removed.

(3) Covers are essential to arctic operations if time involved in removing snow, ice, and frost is to be avoided. Covers serve a secondary camouflage purpose when they are colored to blend with the background.

108. Planning Factors

a. The payload capability of aircraft is reduced in northern areas due to the added aircraft weight caused by ski or float installation and required survival equipment.

b. All available charts should be carefully studied to insure that the manufacturers recommended maximum power settings are not exceeded in extremely low temperatures.

c. During winter months, aircraft doors should not be removed for aerial resupply purposes unless canvas doors, or suitable substitutes, are fabricated for use in flight.

d. Windchill factors should be studied and appropriate measures taken to insure proper protection of personnel exposed to propeller and rotor wash.

e. Particular caution must be exercised during external load operations in snow or dry cold air since static electricity is generated more quickly and in much higher voltages than in normal operations. A grounding probe must be used to dissipate static electricity.

f. When operating in mountainous terrain, wind direction and velocity may be indicated by observing drifting snow. Swirling action indicates turbulence.

g. In mountainous areas, snow may accumulate to a depth of several meters. Personnel debarking from the aircraft should toss

out snowshoes and dismount on them to keep from sinking into the snow.

h. Higher fuel consumption must be considered when planning use of aircraft. On extended flights refueling becomes a major problem in the north, because of long distances and inability of surface transportation to move fuel to isolated points.

109. Night Operations

a. Navigation during the hours of darkness is extremely difficult due to the sparsely populated country, although reflection from snow covered terrain serves as an aid to visibility under some circumstances. Navigation through mountain passes after dark, under overcast conditions, is not recommended except for emergency flights.

b. Personnel should receive intensive training in night external loading operations. Lack of visual horizon, blowing snow, and the fact that use of the aircraft lights frequently cause loss of visual reference makes this work extremely dangerous.

110. Navigation

Low level navigation is most difficult due to the monotony of the terrain and lack of detail on many maps. Lakes, which abound in many northern areas, may be used in conjunction with pilotage; however, during spring thaws the number of lakes in some regions is multiplied, making accurate identification extremely difficult. Pilots must exercise caution to insure proper orientation at all times.

111. Maintenance

a. The problems of increased maintenance stem directly from the low temperatures. Special precautions and equipment are necessary to insure efficient operations of the aircraft. Operation of aircraft at temperatures below —50° F. should not be attempted except in emergencies.

b. Engines should not be started at temperatures of 10° F., and below, without use of an electrical power unit for assistance in starting. A source of external heat for application against engine accessory case, carburetor induction system, oil pump, and battery will insure easier starting. The standard portable combustion type heater, incorporating a blower and flexible hoses for application of heat to localized areas, may be used for preheating aircraft areas before starting. In addition to preheating engines for starting, these units may also be employed to heat specific portions of the aircraft so that maintenance personnel can work without gloves. When temperatures remain below freez-

ing, aircraft batteries not in use should be removed and stored in a warm place.

c. Thickening of oils at low temperatures presents problems in operation and starting. An aid in extreme cold is the installation of standard winterization equipment which includes baffles on oil coolers to maintain proper temperatures. Oil dilution units may also be installed, although it is normally satisfactory to drain the oil from engines at the end of the day's operations and to heat it prior to replacing it in the engine.

d. Wheels should be kept on dry surfaces or blocks to prevent them from freezing to the ground.

e. Mooring of aircraft is made relatively simple in regions of extreme cold by the expedient of placing one end of a rope on the ground, covering it with snow, melting the snow and allowing it to freeze fast, then mooring the aircraft.

f. Maintenance time factors may be quadrupled in areas of extreme cold. Aircraft mechanics are greatly hampered by the heavy winter clothing and gloves. Installation of auxiliary equipment such as winter cowls, oil dilution systems, personnel heaters, and covers also adds a time factor to normal maintenance operations.

g. Shelter must be provided for personnel performing maintenance. In the absence of maintenance tents, an expedient can be improvised by deploying a personnel parachute and inflating it, using the standard portable heater.

112. Survival

a. Training. A healthy respect for the northern climate and terrain should be engendered in all personnel. Personnel should attend a course in living in the field. This course covers construction of shelters, signals, wearing of clothing, and living off the land.

b. Equipment. Proper clothing is necessary for all personnel. Aircraft survival kits should be carried on all flights.

Section V. CHEMICAL, BIOLOGICAL, AND RADIOLOGICAL OPERATIONS

113. General

The principles for employment of chemical, biological, or radiological agents in northern latitudes are the same as for temperate climates. The application of these principles to operations in northern latitudes or at low temperatures (below + 32° F.) must be based upon a thorough understanding of the peculiar characteristics of the area of operations, structure and tactics of the

operating forces, and the technical limitations of CBR materiel. Force structures and characteristics of northern areas are discussed elsewhere in this manual.

114. Toxic Chemical Agents

a. Production of Casualties.

(1) Low temperatures have an adverse effect upon the casualty producing characteristics of most toxic chemical agents. A toxic chemical agent, to produce a casualty, must gain entrance to the body through inhalation, ingestion, or penetration of clothing and the skin. Nerve agents, blood agents, and choking agents are usually most effective in producing casualties when entry to the body is through the respiratory system. Nerve agents are also effective when absorbed through the skin. Blister agents, such as the mustards, (H, HD, HN) are usually employed to produce blisters upon contact with the skin, but may also produce casualties upon inhalation of vapors. The nerve and blister agents will also produce casualties if taken into the body in contaminated food or water.

(2) For a toxic chemical agent to produce a casualty through the respiratory system, the agent must be capable of being vaporized or converted to aerosol. While the freezing point of a toxic compound is not an exact indicator of its volatility, generally, the lower the temperature, the more difficult it becomes to vaporize or aerosolize a given toxic chemical.

(3) Best results are obtained from the presently standard chemical munitions when the agent fill is in liquid form. This limits the number of toxic chemical agents which can be used effectively for attack through the lungs. Lower temperatures also reduce the rate of penetration of liquid agent through clothing. Freezing points for most known chemical agents may be found in TM 3–215.

(4) The increased difficulty of establishing casualty producing concentrations of vapor or aerosol at low temperatures may be offset by the added difficulty of accomplishing necessary protective measures. Since the individual may be exposed to the lower agent concentration for a longer period of time, he may still receive a casualty producing dose of the agent. The exact effect of these conflicting factors; i.e. increase or decrease in casualties to be expected from a given ammunition expenditure will vary with temperature and agent employed. In gen-

eral, no appreciable reduction in total casualties resulting from toxic chemical attacks is expected.

b. Tactical Employment.

(1) Since weather, terrain, and logistical considerations limit the size of forces which can operate effectively in northern latitudes, the size of the available targets for chemical attack will usually be small.

(2) The offensive capabilities (excluding aerial delivery) of units in terms of ability to deliver toxic chemicals will be limited. This limited delivery capability dictates that the usual method for conducting toxic chemical attacks will be to place the available concentration of fires directly upon those small well located target elements which are most vulnerable to chemical attack. "Time on Target" fire techniques will be utilized by artillery to place a maximum number of rounds on the target in minimum time. Fuze settings should be varied depending upon the nature of the soil, depth of snow, and type of target being attacked.

(3) Mine fields, placed to restrict the enemy the use of key terrain, should be composite mine fields. The chemical mines should be placed to force the enemy off the road net and to utilize undesirable terrain. Approaches to bridges and bridge abutments can be contaminated at the time of destruction of the bridge, to delay any reconstruction.

c. Defensive Measures. Problems of individual protection are complicated by low temperatures since protective masks require some degree of winterization and most other protective items must be protected against freezing. The most common problems encountered are listed below.

(1) In extreme cold, the protective mask should be carried under the parka or field jacket to keep it warm. When the mask is removed after prolonged wearing, the inside of the mask, particularly the area around the outlet valve must be wiped dry to prevent the outlet valve from freezing. Ice and frost must be kept clear of the inlet valves. As soon as possible after removing the mask, it should be dried out in a warming shelter to insure that it will be functional if required again in the near future. Frost bite of the face may occur if head harnesses are adjusted too tightly.

(2) The individual protection and treatment set must be protected against freezing. Freezing and thawing does not affect the therapeutic value of atropine but freezing

may rupture the atropine injector. At low temperatures the protective ointment cannot be removed from the tubes, nor can it be effectively spread over the skin surfaces.

(3) Reagents in the chemical agent detector kits must be protected from freezing. While agent sampling can be accomplished at any temperature, the subsequent steps of "developing" the test in the detector tube must be accomplished in a heated shelter such as the cab of a vehicle, warming tent, etc.

(4) Water, the most common ingredient in decontamination operations, is useless if temperatures are much below 32° F. Certain organic solvents may be used for limited decontamination of essential equipment such as weapons, vehicle doors, and loading ramps etc. Extreme care must be exercised to insure that the organic solvents are not allowed to come in contact with clothing or flesh of the individuals performing the decontamination. Special care must be exercised when using solvents to properly decontaminate or dispose of the contaminated solvents.

(5) The multilayer clothing normally worn in freezing weather offers fairly good protection against skin absorption of frozen persistent chemical agents. However, there is a great danger to personnel wearing contaminated clothing in a heated shelter. The heat will volatilize the chemical agents and can thus produce casualties.

115. Biological Operations

a. General. Biological operations involve the employment of biological agents by a weapons system to produce casualties, primarily among personnel. Essential to planning biological operations is consideration of probable effects on civilians, whose diseases may affect adversely troop health or who may be desired as a labor force.

b. Logistics. Most biological agents require cold storage because of the extensive biological decay which occurs at high temperatures. The prevailing low temperatures in the northern latitudes will reduce the requirement for this type of storage, thereby decreasing the logistical effort required for biological attack.

c. Influence of Temperature on Area Coverage. High temperatures will increase the biological decay of biological agents and thereby reduce the downwind travel of the living agent. Low temperatures will, therefore, increase the area coverage of biological weapons, thus enhancing an important characteristic of

them — that of searching and seeking out widely dispersed enemy forces.

d. Defensive Measures. The protective mask is the first line of defense against a biological attack. When the mask is fitted properly it will afford complete protection against a biological agent delivered in aerosol form. The next best means of protection against biological agents are a clean body and the natural body defenses. To insure that natural body defenses are performing satisfactorily, the body requires proper diet, rest, avoidance of overexertion and chill, and consumption of at least 2 quarts of water per day. Since it is more difficult to satisfy body requirements for food, water, rest, and cleanliness at low temperatures, commanders must give this matter close attention. Troops suffering from dehydration, or from lack of nourishment or rest, will be particularly vulnerable to biological attack.

116. Radiological Operations

a. General. Because of the limited road nets and avenues of approach, nuclear radiation can have a definite effect upon all operations. The sources of this radiation and the characteristics of each source are discussed in the following subparagraphs.

(1) *Neutron Induced.* This radiation hazard can result from an air or surface burst nuclear weapon and exists on the ground symetrically around ground zero. Weather has no appreciable effect on the location or size of a neutron induced area, hence patterns on the ground will be determined entirely by the weapon design, yield, height of burst, and by the presence in the soil of elements which can be made radioactive by neutron capture.

(2) *Fallout.* Radiological fallout patterns of military significance extending downwind from ground zero result from surface or subsurface bursts. The size and shape of these patterns are directly dependent upon the fission yield of the weapon, height of burst, and the speed and direction of the wind at all altitudes from ground level to the maximum altitude to which the nuclear cloud rises. The degrading effect of snow cover and permanently frozen soil on the production of fallout is not completely known. During the winter months in northern latitudes, winds at higher altitudes are characterized by high velocities and by rapid changes. For this reason, units in an area of possible fallout should take advantage of the best protection available until the actual development of the fallout pattern on the ground has been determined.

b. Monitoring and Survey.

(1) A large majority of the standard military radiac instruments operate on the principle of a gas which is contained in a small chamber, over which has been superimposed an electrical field. For instruments to perform efficiently, the voltage across this electrical field must be maintained within prescribed limits. If the voltage drops below that prescribed for a particular type instrument, the meter readings obtained in a radiation field will vary considerably from actual dose rates. Since the voltage to operate the instrument is obtained from batteries and the efficiency of batteries is reduced by low temperatures, special precautions must be observed to keep the batteries warm.

(2) When units are operating in a situation or area where radioactive contamination is possible, monitoring is accomplished at regular intervals as specified in the unit SOP. Surveys are normally limited to areas and routes occupied or used. Surveys of unoccupied areas or for new routes are time consuming and difficult to accomplish. The limited road net and restrictions on cross-country mobility force reliance upon aerial survey as the primary means for accomplishing surveys of larger areas.

c. Protection.

(1) Shelters which provide necessary warmth for living will also provide some degree of protection from radioactive fallout. During winter months the ground will be frozen to considerable depths, making the digging of foxholes or other types of shelter difficult without the use of specialized equipment. Maximum use, consistent with the tactical mission, must be made of natural terrain features to provide protection against nuclear radiation. Snow and ice, although not as effective as earth in reducing radiation hazards, are readily available and can be used to provide shielding against radiation effects. Loose snow falling on a contaminated area has a half-thickness of about 64 cm; that is, 64 cm of loose snow covering the contamination will reduce the dose rate to about half the original value. 30 cm of hard packed snow will reduce the dose rate by about one half and may be of value for constructing radiation shields over contaminated areas or around shelters.

(2) Low temperatures will also make the decontamination of personnel who have been in radioactive areas more dif-

ficult. The requirement that contaminated personnel be provided with bathing facilities and a change of clothing must often be modified and field expedient methods utilized. Field methods consist of removal and vigorous shaking of all outer clothing, or the use of brushes improvised from shrubbery for brushing the clothing. When in a contaminated area, personnel should keep clothing completely buttoned in order to keep to a minimum any contact of radioactive materials with the skin. Tracking of contaminated snow into shelters and populated areas can be minimized if trails and roads are scraped after fallout ceases. If practicable, the removal of the top layer of contaminated snow within an occupied area will materially reduce the radiation dose rate.

117. Flame Operations

a. Flame operations can be utilized to advantage in both offensive and defensive operations in the northern latitudes. The standard portable and mechanized flame throwers have the same limitations as other mechanical type weapons containing moving parts and rubber components when operated at low temperatures. Both weapons must be winterized as prescribed in TM 3–376 and FM 31–70 before they will perform satisfactorily. In addition to winterizing the weapons, special procedures must be followed in preparing thickened fuels used by these weapons to insure that the fuels will gel. These procedures involve either heating the fuel ingredients or, if this is impractical, using a chemical additive called a peptizer. Thickened fuels should not be stored for extended periods of time, since they tend to deteriorate after 48 hours and may not work satisfactorily.

b. At low temperatures, the ignition of flame thrower fuels may not occur readily. To insure ignition, two or more charges from the ignition cylinder should be ignited before firing a burst. SOP for the employment of flame weapons should provide that sample batches of thickened fuels be prepared and the weapons be test-fired under conditions approximating those expected to be encountered at the time of employment (TM 3–366 and TM 3–376).

c. Flame expedients involving the use of thickened and unthickened fuels do not suffer from the same limitations as do mechanical flame throwers. These weapons, if properly fabricated and emplaced, will perform satisfactorily under all conditions of temperature. Since ignition at low temperatures is more difficult, additional ignition charges in the form of incendiaries should be incorporated in flame expedients.

d. Low temperatures have little or no effect on the functioning of air-delivered flame munitions. In preparing thickened fuels, the same procedures should be followed as for other flame throwers and, if possible, test firing of the munitions should be accomplished under conditions approximating those expected to prevail at the time the weapon is to be employed. In northern latitudes, air-delivered flame weapons are particularly suited for attacking troops in field shelters and fortifications.

e. The fire starter is a flame type munition designed to assist in starting fires under adverse weather conditions. This munition will function satisfactorily with no special handling procedures required for use in extreme low temperatures. Unit SOP's should provide that individuals or small detachments operating along or away from the main body in northern latitudes carry fire starters in their personal equipment. SOP's should also provide that fire starters be included as part of the survival equipment carried by all Army aircraft, tanks, and vehicles.

118. Smoke

Ideal meteorological conditions exist during the greater portion of the year for the employment of smoke. Standard artillery munitions, smoke pots, and grenades filled with smoke-producing chemicals may be used with the following limitations.

a. Base injection artillery smoke shells containing canisters filled with HC smoke mixture are not considered effective for use on terrain covered by loose snow because the canisters bury themselves in the snow and are extinguished by water from the melting snow. However, if these munitions are used on terrain covered by hard packed snow and ice, they lose little of their smoke producing capability. Artillery shells filled with WP (white phosphorus) will likewise become buried in the snow and will lose much of their effectiveness in producing casualties or a smoke screen under these conditions. However, WP is the most effective smoke shell for use in northern areas.

b. Burning type smoke munitions such as smoke pots and grenades function satisfactorily at low temperatures. However, these munitions generate heat and will, if used on snow-covered terrain, burrow into the snow and become extinguished. By clearing the snow so that these munitions rest on the solid earth, it is possible to use burning type munitions to produce a good smoke screen.

c. Bursting type munitions, such as the WP grenade, function satisfactorily at low temperatures and require no special handling procedures. However, the grenade, if used on snow-covered terrain, will also lose its effectiveness as a result of drop-

ping through the snow. Under these conditions, the explosive force of the grenade is smothered and the number of grenades required to produce a smoke screen or a casualty effect increases to such an extent that their use is not recommended.

d. Mechanical smoke generators present no operating problems if properly winterized. Before a decision is made to employ mechanical smoke generators the commander should assure himself that the logistical problem of supplying large quantities of fog oil to the generator sites can be solved.

Section VI. NUCLEAR WEAPONS

119. General

Weather conditions in northern latitudes modify the blast and thermal effects of a nuclear detonation. Although initial nuclear radiation is not greatly affected by weather, fallout patterns and the range of initial gamma radiation are influenced by weather conditions. Since there is no satisfactory quantitative method for determining the exact extent to which blast and thermal effects of a nuclear detonation are affected by weather, a qualitative assessment must be made. The reflectivity of the surface resulting from frozen ground and snow conditions can produce an increase in the hazard to our own troops from blast and thermal effects.

120. Influence of Weather and Terrain on Blast

Unfrozen muskeg and tundra provides average blast-reflecting surface. This type surface will absorb some of the shock wave energy from a nuclear explosion and will materially reduce the distance to which a given over-pressure will extend. On the other hand, this same type terrain, when frozen or covered with ice or packed snow, becomes a good blast-reflecting surface and results in a substantial increase in the distance to which a given over-pressure will extend. A newly fallen, loose blanket of snow makes a very poor reflecting surface and will result in a decrease in blast effects.

121. Influence of Weather on Thermal Radiation

a. The damage produced by thermal radiation from a nuclear detonation is dependent on the amount of incident thermal energy and the susceptibility of the target elements to damage by thermal energy. Both of these variables are affected by weather conditions.

b. Terrain covered with muskeg and tundra, or which is wet, is an average reflecting surface and will reduce the effectiveness

of thermal radiation. On the other hand, terrain covered with snow is a good reflecting surface and increases the effectiveness of thermal radiation. Under certain conditions, ice fogs are easily generated at low temperatures; this creates a condition unfavorable for the transmission of thermal radiation.

122. Protection Against Nuclear Attack

At low temperatures, troops operating in the field are particularly vulnerable to all of the effects produced by a nuclear detonation because of their inability to dig foxholes and underground fortifications. Shelters and fortifications constructed from snow and ice provide some protection and, wherever possible, should be constructed to take maximum advantage of the additional protection provided by natural terrain features. During the winter months, the trunks and limbs of trees will be frozen and become very brittle and will be converted into many projectiles moving at high speed. Unprotected personnel in blast areas will suffer many punctures and lacerations from these projectiles. The snow covered terrain and the atmosphere of some regions of the Far North increase the reflectivity and improve the transmission qualities of thermal radiation, however heavy, larger type clothing furnishes virtually complete protection against thermal radiation, outside the radius at which other effects will govern.

Section VII. ENGINEERS

123. General

Engineers in northern operations carry out their normal combat, combat support, and service support missions. Special aspects of service support tasks are covered in TM 5–349 and FM 31–70. Environmental factors increase the volume and scope of engineer operations and the difficulties attendant to execution of these operations. The scarcity of roads increases the need for road construction. At the same time, the effect of the extremes of climate increases the manpower and equipment effort required for both road construction and maintenance. The numerous streams, swamps, and lakes necessitate increased quantities of stream crossing equipment and correspondingly increased effort for its installation and maintenance. Cross-country movement of large forces requires augmented engineer effort. The problems confronted in construction of conventional engineer field works are magnified, as are the problems of installation of field fortifications. While water potential is normally adequate, the difficulties of supplying potable water by conventional methods are increased.

124. Field Fortifications

a. Troops must be capable of constructing field fortifications on snow and frozen ground using materials available. This can include constructing obstacles with wire, mines, and timber under the special conditions of winter and by the icing of banks and the preparation of traps in the ice of rivers and lakes.

b. Excavation is difficult in frozen ground. In frozen ground, hand tools are of little use. Explosives are effective when properly used, but large quantities are required. An expedient, although slow, method is to build a fire on the ground and dig out the soil as it thaws. Too much thawing of large areas, however, makes digging difficult unless there is adequate drainage. Gravel is easier to excavate because it does not freeze as solidly as silt or clay and has better drainage.

c. Hastily made firing positions and trenches are built in the snow and reinforced with readily procurable material such as ice, wood, or branches. A minimum of 2 meters of solidly packed snow is required for adequate protection from small arms fire. If possible, positions are dug into the ground. Special tools and explosives are required for this purpose. Shelter is built simultaneously with the construction of positions.

d. Weak spots in the defense, where there is little snow or which are easily traversed by the enemy, are reinforced with artificial barriers such as wire entanglements (especially concertina wire), pitfalls, abatis, antitank mines, antipersonnel mines, and iced slopes. To insure activation, pressure type antipersonnel mines should be placed on a firm bearing surface such as boards or large rocks. The M16 antipersonnel mine activated by pull or pressure type fuze is effective on ski trails. Trip wires just above the surface of the snow attached to mines may be used in an alarm system. In forested areas, measures should be taken in summer to protect defensive positions against deliberately set forest fires. Fire breaks should be prepared in areas where this is likely to occur. Low ground in front of the defense position can sometimes be flooded by construction of a dam.

e. Dummy positions, which are especially effective in winter, are used extensively to mislead both ground and air observation. Road and trail networks are coordinated with the plan of defense. This will include roads and trails for movement of reserves, artillery, and supplies. Care must be taken to provide maximum concealment of all routes, especially those to positions in forward areas. Seasonal changes will affect defense positions. The breakup seasons will usually destroy positions built during the winter and will fill low spots with water. During the breakup season, special

attention is paid to drainage of trenches and shelters. Positions or obstacles built during the summer may be made useless by heavy snow in the winter.

f. Breastworks of snow can be erected if time is short. Sandbags filled with sand or snow are effective in the silent and speedy construction of defensive positions in frozen ground. Water poured on the bags freezes and improves their protective qualities for the duration of the cold weather.

g. If the snow is deep enough, tunnels can be constructed. They do not provide effective protection against artillery fire, but do afford complete concealment. Snow tunnels must be revetted. Long tunnels should be ventilated with shafts. Snow walls must be used for cover when the ground is too frozen for trenches. The minimum thicknesses for protection from rifle bullets and shell splinters are given in table I.

Table I. Breastwork Construction

Snow wall material	Minimum thickness in centimeters
Newly fallen snow	400
Firmly frozen snow	250 to 310
Packed snow	200
Ice	100
Icecrete	31
Frozen snow water mixture	125 to 155

Note. These materials will disintegrate under sustained fire.

h. Antitank devices of usual shapes can be made from ice and frozen into place. In forested regions, they can be made from logs.

i. Tank traps can be made in the water in early winter by cutting out a section of ice approximately 4 meters wide and floating it under the ice sheet on the down stream side. It leaves a clear water gap. Prevent refreezing of the gap by laying a mat across it and insulating with a snow cover. The snow also provides concealment. This trap is effective but tends to freeze within a short period of time if not properly insulated. If the ice on the gap is less than 4 cm thick, the trap also serves as an antipersonnel obstacle.

j. A body of water may become an effective barrier by using explosives to break the ice. In blasting, place the explosive under the ice to take advantage of the excellent tamping effect of water. Holes are cut or blown in the ice by explosives and the charges are held in position under the ice by bridging these holes with poles.

k. Roadblocks can be created by icing drifts and roads or by using icecrete, timber, and wire cable in conjunction with mines

and barbed wire. A cable block consists of a piece of 1-inch wire cable painted white stretched diagonally across the road about 60 cm above the surface of the ground. It is most effective if placed so that it is approached by vehicles coming downhill or from behind a blind curve. Antitank mines should be placed in the ditch toward which the vehicle is deflected by the diagonal block. Icing the road near the cable increases the effectiveness. This type of block has the advantage of being easy to construct, difficult to detect, and simple to remove for the passage of friendly troops or vehicles. In forested areas, abatis can be constructed by using fallen trees and barbed wire.

l. Iron pickets are more practicable than wooden pickets in frozen ground. If deep snow conditions are to be expected long pickets must be used. Explosives, power drills, steam jets, and heated iron rods are used to sink holes. Wire can easily be set at the necessary height in woods and forests by attaching it to trees. The wire should be placed close to the ground to prevent tunneling. If time is lacking or there is uncertainty as to the amount of snowfall, the upper strands of wire can be added later. Constant maintenance of wire installations is necessary, especially during heavy snowfall. Concertinas are the best wire obstacles for use in deep snow, however, they must be moved or replaced when hard packed snow covers them. Prefabricated wire devices of triangular cross sections (Lapland fence), with six wires on the enemy side and four wires on the friendly side and on the base, may be placed on snow for temporary use. In case of accumulation of snow, the tripods can be lifted out of the snow with poles or other means and reset on top of newly fallen snow. On the soft ground, the base strutting of tripods and the base wires give enough bearing surface to prevent the obstacle from sinking. The small reflective surfaces of the wire are invisible from the air at relatively short lateral and oblique distances. Screwpickets, however, should be painted white. Wire devices lose their effectiveness as depth of snow increases and will require continuous surveillance (FM 5–15).

125. Roads and Trails

a. The ability of a force to advance and carry out its mission is affected by the lines of communication and by the terrain over which movement is made and supplies are delivered. Tracked vehicles do not eliminate the need for roads nor should lack of roads limit the scope of operations.

b. Roads made by combat troops under winter conditions will be improved only to the extent of the capabilities of organic equipment. Roads must be made wide enough to accommodate vehicles

which will be using them but, because of the necessity for concealment from enemy air, unnecessary clearing is avoided. On single track roads, frequent turnouts must be provided to permit two-way traffic.

c. Tractor trains operating on properly constructed trails can move large tonnages. They can be used to advantage on lines of communication and in rear areas, but because of their slow speed and vulnerability to attack they are not normally used forward of the brigade supply point.

d. The vast roadless areas of the north become, under summer conditions, even more difficult for overland vehicular movement than during the winter months when the ground and waterways are frozen. Combat troops are frequently required to construct temporary summer roads and bridges along the routes of communication without engineer support. In contrast, winter roads are generally constructed on the ice of waterways or along the frozen swamps and muskeg areas, the summer routes are selected to follow the high ground, floods plains of the braided streams, shallow rivers, and the shore lines of gravel bottomed lakes—all characteristic terrain features of the northern regions. If a swamp must be crossed, it is done at the narrowest point requiring the least ground reinforcement. In heavily forested areas, existing game trails, clearings, and lanes through the trees may be widened and used for roads. Techniques of road construction under summer conditions in the Far North are contained in the TM 5–300-series.

e. The construction of snow roads for wheeled and tracked vehicles and snow removal or compaction on all types of roads and trails is important. Normally, snow is removed by snow plows, graders, angledozers, and drags. Early winter snow clearance accelerates the penetration of frost into any unstable subgrade, consolidating the subgrade. The snow removed from the road is scattered away from road ditches. Piling of snow or forming of snow banks along the road creates a condition favorable to the deposit of snowdrifts. Deep-rutted snow which is hardened by traffic or freezing can be leveled with harrows, drags, graders, dozers, or by packing loose snow into ruts. Road surfaces, culverts, bridge channels, and ditches are maintained and kept clear to provide melted snow drainage. Maintenance of roads made by combat troops for tracked vehicles normally consists of such tasks as straightening sharp curves, filling holes, building turnouts, and draining surface water.

126. Ice Routes

a. In some areas, the best sites for winter road routes will

be found along frozen waterways. They have an advantage in that they are relatively easy to prepare, requiring only snow removal and possible strengthening of the ice in places. The only slopes found on such routes are at the entrance and exit to the waterway.

b. Road routes over and across lakes and streams are selected only after intensive and detailed reconnaissance of ice conditions. This reconnaissance is concerned mainly with determining the ability of the ice to support the heaviest load which it must bear. Thickness of ice is only one factor in determining its bearing capacity. There are many other factors which are discussed in succeeding paragraphs. The reconnaissance for a route over ice must be conducted by personnel qualified to interpret ice characteristics to prevent men and equipment from being needlessly endangered. The entire route over ice must be checked as the ice can differ in many ways in a relatively short distance.

c. Points for consideration during reconnaissance:

(1) Along the shores, the ice formation is thin and weak and more likely to develop cracks than in the center of the frozen stream.

(2) Where an under ice current of water flows through a large area of ice, the ice in contact with the current is subject to greater variation of temperature in a given period of time than ice in the adjacent or surrounding areas.

(3) Shallow water ice is usually thinner than deepwater ice.

(4) Good quality ice is characterized by being clear and free from air bubbles and cracks.

(5) Muskeg lakes contain a great deal of vegetation which retards freezing and results in weak ice.

(6) The carrying capacity of additional reinforcing ice layers formed by alternate freezing and thawing and additional ice formed from slush is taken as only half that of prime natural ice.

(7) During freezing weather, the thickness of ice is increased by clearing the snow cover.

(8) Ice which is left unsupported because of a drop in a water level is of reduced strength.

(9) During extremely cold weather, the cracks caused by the contraction of the ice may be enlarged by heavy traffic.

(10) In spring, the main body of ice can be traveled over even though water is on the surface. There may be potholes through the ice when the surface is covered with water. When the ice is covered with water and then

rises above the surface of the water, it is brittle and likely to crumble under leads.

d. The strength of ice is dependent on its structure, thickness, temperature, and underlying support. Strength is greatly increased at low temperatures. An increase in strength with lowering of temperatures is rapid from the freezing point to about 0° F. The strength of the ice remains fairly constant at temperatures below that point.

e. Ice which is cloudy or milky is not as strong as clear ice. The cloudy or milky condition is caused by gas or air being trapped within the ice. This type of ice may form over a lake or swamp (muskeg), which has decaying vegetation on its bottom. When testing the thickness of ice, it should be determined whether the water level beneath the ice has dropped. If the ice is no longer supported by the water, it may be too weak to support heavy loads. This condition is likely to occur in shallow streams. Ice over running water should be carefully tested to discover whether the current has eroded the underside of the ice. This is especially necessary where there is snow cover.

f. In thawing, freshwater ice may separate in vertical prisms (candles) which are extremely weak although the ice as a whole may be over a meter thick. Thawing and candling may be retarded by covering the ice surface with a blanket of compacted snow to shield the ice from the direct heat of the sun.

g. Ice deforms under a continuing load. After a load passes over it, the ice recovers, almost to its original shape. If a load is allowed to stand still on the ice, the ice surface will depress and may reach the danger point. This "load" is then the critical weight for the strength of the ice at a particular location or in a particular condition. During the thaw period, ice becomes dull and brittle, losing its load-bearing capacity. At such a time, heavy traffic wears through ice quickly. Except at the thaw period, cracks transverse to roads across ice do not indicate weakening of the load-bearing capacity of the ice. Transverse cracks may be repaired by filling them with water, which freezes on standing. Cracks parallel to a roadway across the ice indicate that the roadway should be relocated at once, as the ice can no longer carry the load.

h. Preparation of river ice for traffic may be facilitated by flooding the crossing belt between two previously prepared, snow-packed dams. The inclusion of a corduroyed section will help increase the ability of the ice to support a crossing load (fig. 22 and table III).

i. The strength of ice varies with the structure of the ice; the purity of the water from which it is formed; the cycle of forma

tion, or freezing, thawing, and refreezing; temperature; snow cover; and water currents. The sustaining capacity of ice is not definitely fixed but experience and tests provide working capacity figures for good quality ice of varying thicknesses (table II).

Table II. Load Bearing Capacity of Fresh-Water Ice

	Ice measurements in centimeters for temperatures 0 to 10 F.		Distance in meters between units
	Risk	Normal	
Single Soldier on skis	4	5	5
File of Soldiers — 2 Pace intervals	8	10	
Vehicles:			
¼ ton Truck	15	20	15
¾ ton Truck	20	25	20
2½ ton Truck	35	40	25
5 ton Truck	45	55	60
5 ton Tractor & Trailer Loaded	80	90	80
M–116	30	35	15
M–113	40	45	25
D–7 Tractor	45	50	40
D–8 Tractor	50	60	50
Crane 20 ton	55	60	70
Grader	35	40	50
Tank M–41	50	65	60
SP M–52	55	65	50
APC M–59	45	55	50
Tractor M8–A2	55	65	70
Aircraft:			
H–13	15	18	N/A
H–21	30	35	N/A
H–37	45	50	N/A
L–19	15	20	N/A
L–20	20	25	N/A
L–23	20	25	N/A
U1–A	25	30	N/A
C–47	45	50	N/A

Vehicles other than aircraft should maintain speeds of not more than 16 km per hour—for water from 3 meters to 6 meters deep, and 32 km per hour for deeper water.

j. The values given in table II may require alteration because of climatic variations. Generally, the alteration is toward requiring greater thicknesses and intervals between tracks than given. During freezing weather when the ice surface is free of snow, it is usually of good quality. Temperatures above freezing thaw the ice and deteriorate its quality. An alternate freezing-and-thawing process normally produces ice of poor quality. Snow cover may limit the thickness of the ice formed, or may prevent rapid

thawing if a thick coat of ice is formed and then covered with snow. Thaws in the watershed may cause flooding of the ice because of an increase in the amount of runoff, and freezing may cause the stream water level to drop due to a decrease in runoff. Both conditions affect the quality of the ice.

k. An expedient for a tactical crossing of skiers, snowshoers, and oversnow vehicles may be used when a detailed prior reconnaissance is impossible. Leading men of the trailbreaking party are roped together. The lead trail breaker in a prone position drives an axe into the ice at arm's length; if the ice sounds solid he moves forward 5 meters and tests again.

l. The simplest method of reinforcing ice is to put layers of snow on the surface and pour on water to freeze them. Each layer is frozen before another layer is added. Another method of in-

Figure 22. Corduroy road over frozen river

creasing capacity of the ice is to add and freeze to the surface several layers of boughs or straw, each about 5 to 10 cm thick. Boards, planks, and small logs may be used to form tracks or runways for vehicles or sleds. Each track is at least a meter wide. Sleds made of logs help in distributing heavy axle loads. (For a guide in a reinforcement of ice, see table III.)

Table III. Reinforcement of Fresh-Water Ice

Material	Thickness of reinforcing layer	Requirement for 4 meter track	Increase in bearing capacity, assuming 10 cm ice thickness
Ice and snow	3 layers of 4 cm		1/6
Straw	5 to 10 cm	20 pounds per meter.	1/5
Straw, 3 layers	Each layer 5 to 10 cm.	20 pounds	1/4
Brush	5 to 10 cm	7 cubic feet per meter.	1/4
Ice Block	Dependent on size of blocks.		
Planks, 5 cm		Two runways 1 meter wide.	1/2

m. Maintenance of ice crossings is mandatory and includes reinforcement, snow clearance, approach road maintenance, and surface repair and improvement of wearing surface. Snow clearance is carried out to make the crossing trafficable to vehicles to allow inspection of the ice surface, and to influence the freezing or thawing of the surface. Approach road maintenance is the same as that required for bridge and ford approaches. Badly worn or rutted surfaces are repaired by blading and filling or by re-covering the surface with snow and packing and freezing. Ice crossing lanes should be separated by 45 to 60 meters.

n. In some instances, the destruction of ice crossings is desirable to prevent their use by the enemy. The most suitable means of destroying ice crossings is to use explosives.

127. Airfields

a. The preparation of airfields for fixed-wing aircraft depends upon the conditions encountered. In deep snow, the surface must be smoothed and packed by the use of a drag or by driving vehicles over it. With a small amount of pioneer work, hard-wind-packed areas can be made usable for aircraft equipped with skis.

b. Deep soft snow presents difficulties in the landing and takeoff of airplanes, even when they are equipped with skis. The

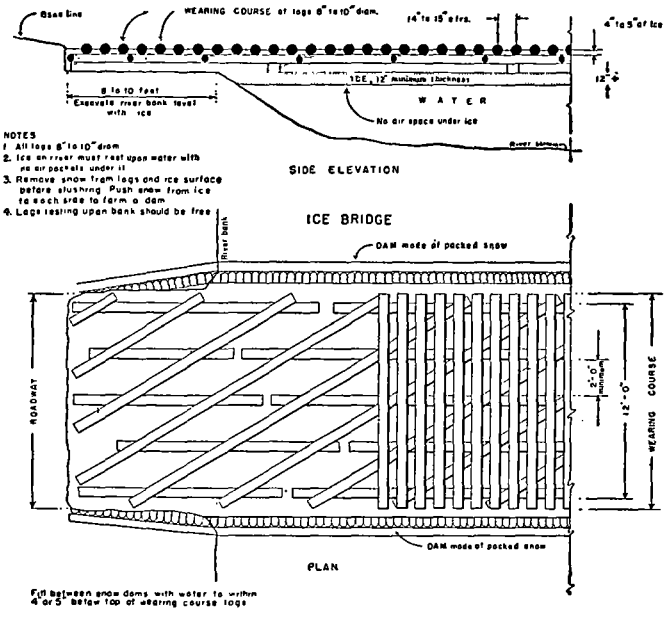


Figure 23. Ice bridge construction

deeper a ski sinks into the snow, the longer will be the ground run required for takeoff.

c. Preparation of Landing Sites for Helicopters.

(1) The amount of effort exerted toward improving landing sites will depend on their intended use. The procedures discussed here are primarily for sites in forward areas that are to be used infrequently, or possibly for only one emergency mission. Even though no elaborate preparations are necessary for this type operation, the unit commander should realize that the state of development of sites adjacent to his unit will greatly influence the reliability of support he receives from helicopter units. Inasmuch as site locations seldom will be found that satisfy all requirements, some preparation will usually be required.

(2) If trees must be cut to clear a landing site or approaches thereto, stumps in the immediate vicinity of the landing spot should not exceed 30 cm in height because of the possibility of puncturing the bottom side of the helicopter fuselage. Also, it is seldom desirable to prepare a wooded area by burning because of the dust problems which will be created.

(3) Landing sites may be prepared on the sides of hills by blasting a ledge. However, the slope gradient must be considered when preparing such sites.

(4) Even though the terrain surrounding the troop unit's position is hilly and wooded, a suitable landing site still may be prepared. First, enough trees are felled in the vicinity to provide a clearing for the site. These are wedged among the stumps on the lower side of the slope to provide a foundation for the site. Earth above the proposed site is then dug out and filled in around the tree trunks on the site. Care must be taken to insure that the filled-in portion is solid enough to support the weight of a cargo helicopter. For security reasons, the site should not be cleared or filled more than necessary so that its position will not be easily detectable by the enemy. Unnecessary digging should be avoided as this creates a dust hazard.

(5) Sites in cleared areas, fields, and roadways are easily prepared for landing. When extremely dusty conditions prevail, it may be desirable to prepare the ground with oil or some other form of soil stabilizer. Small trees are felled, holes filled in or marked, and all loose rubble or objects cleared from the area. Loose objects, such as inadequately secured panels, may be drawn into the rotor system and cause damage, or loose rubble or debris may be blown against personnel on the ground resulting in injury.

(6) It is especially important that all communication wires strung between trees or across valleys in the vicinity of landing sites be removed or lowered to the ground. If the wires are in use and cannot be strung along the ground, they must be marked. This can be done with strips of cloth of highly contrasting colors hung across them at intervals to make them clearly visible to the pilot during takeoff and landing.

128. Camouflage

a. Camouflage techniques include the correct use of camouflage clothing; the camouflaging of shelters, weapons, defensive positions, camps, and bivouacs; and the selection of sites making the best use of natural camouflage. Camouflage will often require the use of nets and natural materials, the enforcement of track discipline, control of lights, smoke, noise, and practice in deception using available natural materials and specially constructed dummies.

b. Snow exaggerates contrasts and makes camouflage essential. If possible, tracks that reveal positions should be covered. Deceptive track plans are essential. Snow and other natural materials should be used to conceal trenches and foxholes by placing loose snow on the side of the enemy. The slope of the snow should be gentle with all sharp angles hidden. Locations of emplacements and vehicles are chosen to take advantage of existing dark patterns. Dummy installations should be erected profusely (FM 5–20 and FM 31–70).

c. Issue camouflage nets, wire mesh, and garnishing materials used for camouflage on snow covered terrain should be whitewashed or painted with white paint to improve their effectiveness. Vehicles and artillery pieces should be pattern painted or painted solid white to blend in with the surroundings.

129. Mines and Mine Fields

a. For use in snow, mines should be white and the tracing tapes colored. As much work as possible should be done in warm shelters to increase the efficiency of both the men and the mines. Arming of mines in quantity is a difficult task in low temperatures. When mines are laid in the snow, track discipline is important. With no snowfall imminent, a well-tracked terrain is best for mine fields.

b. Antitank mines are not always effective under heavy snow cover. When they are buried too deeply, the snow causes them to become bridged over. The mines may be placed on the ground where the snow has been removed or near the surface of the snow on rock ice, or other support. A thaw or concentrated traffic often renews the effectiveness of a snow-covered mine. The mine may fail to detonate if water has entered it and become frozen. In deep snow, antipersonnel mines need bearing devices to keep them near the surface. Minefields should be inspected periodically and necessary maintenance performed. White painted trip wires are effective. Mines should not be lifted in extreme cold, when they are equipped with antilifting devices, or when frozen to the ground. Under such conditions they should be destroyed in place.

c. To emplace ice mines, holes are drilled through the ice and mines are suspended by cords about 60 cm below the ice. The field is laid so that the mines are staggered about 3 meters apart. The field is sympathetically detonated by electrically exploding one or more of the mines in the field. Gaps 10 to 15 meters in width may be blown depending on the thickness of the ice and the num-

ber of mines used. Mines are used for blowing holes in ice to create open water gaps. Defensively, they can be used to restrict the enemy from using ice on lakes or rivers as avenues of approach or as routes of withdrawal. In an approach march or an attack over ice, they can be used to protect open flanks. For ice minefields, see FM 31–70.

d. Antipersonnel mines are used for mining ski and other tracks in snow. When a pressure type firing device is used, the mine must be placed about 2 cm under the snow surface because the weight of an individual is distributed over the length of the ski. When a pull type firing device is used, the trip wire is placed at various heights above the snow surface by tying it to the trees and saplings off of the trail. All extra tracks must be swept away by using tree boughs as a broom.

130. Employment of ADM

Principles governing tactical employment of Atomic Demolition Munitions are covered in FM 5–26, FM 100–31, and FM 101–31, and are applicable to northern operations. Technical aspects of systems are contained in the TM 39 series.

131. Problems for Engineers and Commanders

a. Commanders must be capable of employing ADM in northern operations. Conditions of weather and terrain must be considered and plans must include —

(1) Protection of personnel and equipment.

(2) Loading and unloading equipment.

(3) Tactical transporting equipment.

(4) Communications.

b. Existing engineer organizations can be adapted without difficulty to northern conditions, however, modifications will usually be required in the type and nature of their equipment. This in turn will necessitate some revision of specialist requirements. Such modifications and the overall requirement for engineer units, however, vary much more widely in the north than in other regions with the season, the operational theater, and the mission of the force. During the planning stages, all these factors

must receive detailed study to determine the proportion of engineers in the task force, the type of equipment needed, and the organization they require.

c. Environmental characteristics of the Far North which complicate engineer tasks are —

(1) Permafrost.

(2) Extreme and rapid temperature changes.

(3) Wind, snow, and ice storms.

(4) Flooding.

(5) Alternate thawing and freezing.

d. Specific engineer tasks complicated by northern conditions are —

(1) Water supply.

(2) Fire protection systems.

(3) Road construction and maintenance.

(4) Bridge construction and shore work.

(5) Construction of appropriate defensive systems.

(6) Mine and antimine warfare and reduction of other obstacles.

(7) Construction of airfields, airstrips, and helicopter landing sites.

(8) Installation and maintenance of camouflage and decoys.

(9) Construction of storage and supply distribution areas.

e. In the north, as in any undeveloped area, much is required of the engineers to facilitate the movement of the command. Extreme colds adds to the importance of efficient organization for engineer work. Parties forced to stand about idle in the open rapidly become chilled and lose much of their efficiency. Tasks must be laid out, and equipment and materials must be on hand before working parties arrive. Fire-fighting equipment and techniques differ in extreme cold because of the problem of procuring and transporting water. Fire prevention measures and inspection are of the utmost importance and must receive constant attention. Water that is stored for fire-fighting purposes should have calcium chloride added to keep it from freezing. The chief reliance is upon nonfreezing fire-fighting chemicals. It is unsafe to rely on the use of snow to extinguish fires because the snow is usually tramped down around structures within a camp and is therefore unavailable in sufficient quantities.

(1) In the provision of shelters, it should be borne in mind that less fuel is required to provide adequate heat for one large space than if the same space is divided between two or more structures. This is because of the reduced area of outer walls, in the former case, through which heat escapes.

(2) Gasoline burning, portable tent heaters of the air-duct type which rely on a small gasoline motor to operate the blowers can be modified, if electric power is available, by replacing the gasoline engine with an electric motor to make them more reliable in operation and to be less of a fire hazard.

(3) In semipermanent camps, where gasoline or fuel oil stoves are employed, the usual 5-gallon gasoline drums should be replaced with tanks made from one or more 55-gallon drums set up on stands outside the tent or building, with fuel piped inside to the stove. When fuel is piped in from outside, to avoid trouble with water in the fuel settling in low points in the lines and shutting off the flow by freezing, the piping should extend in a continuous grade from the source to the stove.

132. Water Supply

a. The problem of supplying water in the north to units up to the size of battalions or reinforced brigades is much greater than that of individual supply. For instance, melting snow and ice on stoves, burners, or open fires in sufficient quantities to provide water for all needs of large units is impractical because a large amount of fuel is needed to obtain a small amount of water. Seventeen cubic inches of uncompacted snow, when melted, gives only 1 cubic inch of water. Melting of snow is not recommended for supplying water in quantity except in an emergency. The chief sources of water supply for large units in the order of their efficiency and economy are; drawing water from under river or lake ice, melting ice, melting snow, and well drilling (semipermanent and permanent camps).

b. When possible, water points on lakes and rivers are located on the lee side where there is generally clearer water, less snowdrifting, and more shelter from the wind. Sites on a lake are located as far from the shore as possible, within effective camou-

flage limitations. To cut holes in ice at water points, air tools, steam jets, and shaped charges or other explosives prove most effective. Holes can also be drilled through ice by the use of hand augers, however, shaped charges are far superior to hand tools in preparing water holes in thick ice since hand tools are generally inefficient if ice is over 60 cm thick. A point to note in this connection is that the ice will usually be thinnest where it is covered by the most snow. The methods used, however, vary with the condition of the ice and with the equipment, personnel, and time available. At low temperatures, ice rapidly forming over the water in the hole can be kept clear by placing the suction strainer about a foot below the surface when pumping. Continual pumping or insulating the surface keeps the hole clear.

c. If snow is used as a water source for large units, it may be shoveled into any available tank or container and heated by any method available. When powdered or loosely packed snow is used for water, pack it tight in the container and tamp down or stir it frequently while melting to increase the moisture content and so increase its heat conductivity. Granular snow, usually obtainable near the ground, has a higher water content than the lighter snow of the surface layers.

d. In extreme cold, heated shelters are necessary in which to operate water purification units. For highly mobile situations, an inclosed, heated truck-mounted unit or a heated wanigan mounted on a sled can be used to advantage as a mobile water supply unit. This might include a small tank mounted over the stove which provides heat to the wanigan interior, so that the water is heated after it passes through the purification unit and before it is dispensed. Water supply tents or wanigan should be situated on the ice, directly over the hole through which water is pumped or as close thereto as possible, to reduce the possibility of water freezing in the intake hose.

e. Because of the normal low turbidity, it is probable that safe water can be provided by chlorination without pretreatment, if filtration is accomplished by means of an improved diatomite or ceramic filter. Some of the treatment problems encountered in the North are —

(1) Water in certain areas requires heavy chlorination to obtain a standard residual test of 0.4 parts per million after a 30-minute contact period in active parts of distribution systems at fixed installations, and of 1 part per million after a 10–minute contact period under field conditions.

(2) Water softeners and control acidity are required in most cases to prevent scaling in heating systems and power plant cooling systems.

f. For units in the field, water may be stored in insulated 5-gallon thermos jugs and 5-gallon cans. Immersion-type heaters may be used to prevent freezing of a water supply tank or trailer.

g. Field distribution of water to men and small units is handled in several ways. For immediate use, men or units may fill their containers directly from the source. If they do this, they sterilize the water by boiling it or treating it with individual water purification tablets if it is not already sterilized. A water point may be established at a water source such as a lake or river. As the water is pumped from beneath the ice, unit mobile storage tanks are filled and the water then dispensed to men. Individuals may furnish their own cooking and drinking water by melting snow or ice. All field water distribution units are insulated or equipped with some form of heating device to keep the water in liquid state.

h. (1) Transportation of water in the North by truck is practicable only when there is a road net established. The best way to transport water in the north is by the use of track-laying vehicles which are not dependent on a road for maneuverability. If 5-gallon cans are used to carry water, they are filled only three-quarters full to allow agitation of the water during transit. Cans are stored off the floor in heated shelters as soon as delivered. Sled-mounted 250–300-gallon water tanks in which immersion-type heaters have been installed have proved satisfactory.

(2) For small units of two to four men, the 5-gallon insulated food container is satisfactory. These can be filled each night with water from melted snow or ice or from unit water dispensers. They hold enough water for the daily needs of about four men. The insulation is sufficient to keep water from freezing for as long as 40 hours at an ambient temperature of —20° F., if the temperature of the water was at the boiling point when the container was filled.

(3) Disposition of waste water is a constant problem in extreme cold and, even in the summer, in the presence of underlying permafrost. For periods of up to 6 months, satisfactory drains can be constructed by digging or

blasting deep pits, filling these with large rocks and then recovering with about ½ meter of earth.

(4) The steam generator-type snow and ice melting device has many potential uses, including jetting in ice and frozen soil; thawing frozen equipment and water and fuel lines; freeing equipment, tanks, and vehicles frozen into mud or ice; and assisting in the placing of obstacles and mines in frozen materials.

Section VIII. MEDICAL SERVICE

133. General

a. The operation of medical field units in northern operations is basically no different than operation in more temperate zones with the following exceptions:

(1) Medical elements which are intended to be highly mobile should use 10-man arctic tents rather than the larger more bulky general purpose tents.

(2) A means of providing heat in the tents by a nonexposed flame type heater is necessary in patient areas where oxygen or anesthetics are being administered, i.e., ducted, forced air heaters.

(3) The surgeon cannot depend on using existing school houses, office buildings, and similar structures to house hospitals in northern latitudes. Generally housing is inadequate or nonexistent.

(4) In the forward areas under winter conditions, plans for medical evacuation must provide means for keeping patients warm during the process of evacuation. Special evacuation bags and heating devices or heated tracked vehicles to be used as ambulances are a necessity.

(5) Increased numbers of personnel to pull sleds for patient evacuation are required with forward elements when operating in deep snow and extreme cold.

(6) Medical supplies susceptible to damage from freezing must be stored in heated shelter. Under conditions of extreme cold, liquids, whole blood, or blood expanders can be administered only in heated shelter.

b. In the deep snows, storms, and bitter cold of winter, prompt evacuation and treatment of casualties is even more essential than in temperate zones. When feasible, the most successful method of evacuating wounded from the combat area is by air. It is extremely difficult to find and evacuate casualties, and early

medical aid can be rendered only if trained personnel are immediately available. Procedures should be established for rendering medical aid on patrols, at strong points, and in heated first aid stations (tents) near the front lines. If medical personnel are not readily available, arrangement must be made for prompt evacuation of casualties by other personnel. In the muddy seasons, it is necessary to place facilities for emergency treatment well forward in the combat area to prevent unnecessary losses due to time delay in evacuation. In summer the evacuation and care of wounded is hampered by poor road conditions, dust, and insects.

c. Medical officers and aidmen with good physical stamina are essential to successful medical operations. Extensive first aid and self aid training for all personnel in combat units is necessary.

134. Medical Units

a. A medical element should be with the direct support elements to provide backup medical service to the aid station. Consideration should be given to equipping this element with radios which will net with the aid station and also to providing proper vehicles to furnish the same mobility. The medical element should be provided with an X-ray unit and film processing equipment to eliminate the necessity of evacuating all sprains as possible fractures.

b. The backup medical support will be provided by a hospital unit with the general support elements. The size of a task force will dictate the bed requirements and the type unit best suited. The hospital should be housed in medium general purpose tents with liners unless better housing is available. Flooring is considered mandatory. Water trailers should be kept in heated areas or provided with heater units to prevent freezing.

Section IX. ORDNANCE

135. General

The use, maintenance, and repair of ordnance equipment in winter operations in the north establish the need for skill and forceful leadership. The commander who can maintain mobility in extremely low temperatures will often have a decisive advantage. Part of this mobility is gained by the use of low-ground-pressure vehicles for the movement of combat troops and accompanying supplies. This will generate a requirement for sufficient logistical backup to support operations over a dispersed area.

136. Operations

a. In extremely low temperatures, vehicles must be operated periodically to prevent cold soaking of engines and power trains. This requirement makes surprise and concealment extremely difficult.

b. In offensive operations, ordnance direct support units will be located in rear areas and will be engaged primarily in rehabilitation of damaged equipment. Normally, recovery and on site repair by forward contact teams will be exploited to the maximum extent. Recovery capability of ordnance direct support units must be increased due to the effects of heavy snow, extensive muskeg areas, unpredictable weather, and a limited road net.

c. In defensive operations, ordnance support is forward with supported units on maintenance assistance and resupply missions.

d. The operator and one other man must remain with damaged vehicles which are referred to the logistical support units for repair or recovery.

e. Technical intelligence of enemy ordnance takes on added importance in northern winter operations for comparing movement capability of opposing forces.

137. Maintenance

a. The installation, maintenance, and repair of engine preheaters and personnel heaters installed on vehicles for cold weather operations, as well as the changeover to arctic lubricants, requires many man-hours. Low temperatures, with resultant lowering of the lubricants efficiency and increased brittleness of some materials, add greatly to repair requirements throughout the winter.

b. Every element of equipment used in northern winter operations is affected by extreme cold and must be maintained in the best possible mechanical condition. All equipment must be completely winterized in accordance with TM 9–207. Adequate maintenance shelters are necessary and a larger number of experienced maintenance personnel must be available than are normally provided by regulations. Efficiency of the individual and equipment varies directly with the temperature. It may become extremely difficult, due to lack of facilities, for units to perform organizational maintenance when engaged in combat operations. Under these conditions, the responsibility of the Ordnance officer to recommend to the commander ways and means of solving the preventive maintenance problem increases in importance.

c. Some of the maintenance problems to be met are —

(1) Advising using units on the use of proper lubricants

for each piece of equipment. It is important to instruct units to lubricate vehicles immediately after operations. At that time, working parts are warm and maximum penetration of lubricants will result.

(2) Insofar as possible, keeping optical instruments from sudden and extreme changes in temperatures.

(3) Keeping chains, shovels, and sand with all vehicles.

(4) Keeping batteries warm and fully charged.

d. Using units must perform required maintenance if the capability of supporting ordnance is not to be exceeded. In extreme cold, the consideration of performing on site field maintenance on disabled equipment is balanced against available shelter or the possibility of erecting shelter at the site.

e. Condensation of moisture inside of fuel tanks can be minimized by refilling gasoline tanks immediately after stopping for the night.

f. To prevent brakes from freezing, the wheels should be chocked instead of setting the hand brake.

138. Supply

a. For northern operations, all equipment must be combat serviceable with adequate lubricants stored on board. Substandard equipment should not be issued to combat and combat support units since the rapid resupply of major items and second and third echelon maintenance is often difficult.

b. Direct support units should carry higher than normal vehicle float levels and a thirty-day stock of supplies.

c. It is desirable that fourth echelon maintenance activities be connected by adequate lines of communication to direct support units.

d. Supply depots in northern areas must often establish forward dispersed subdepots.

Section X. QUARTERMASTER

139. Service

a. Differences in Quartermaster services techniques required by northern latitudes include the following:

(1) Precautions are required to keep snow out of gasoline and fuel oil during decanting and other handling operations.

(2) Recovery of damaged or abandoned items of equipment must be accomplished immediately to prevent covering by snow or becoming inaccessible in muskeg areas after the spring thaw.

b. Materials handling equipment must be operated with the same cold weather precautions as are other gasoline powered items of equipment. Bath and laundry units should be established immediately adjacent to rivers or lakes to reduce the problem of the water freezing between the source of supply and the water heater and to facilitate disposal of the waste water. Since these facilities are not always within reasonable distance of major units, their equipment authorizations should provide them with organic capability for displacement, organization of area, and resupply.

c. Recovery and evacuation of remains must be accomplished expeditiously to prevent them from being covered by snow.

140. Supply

a. Clothing and Equipment. Requirements exist for many different items of clothing in northern areas. These include waterproof and water-and-wind repellent outer garments, insulated footwear, and hand, body, and headgear designed on the layer principle for protection during extremes in temperatures. TM 10–275 will serve as a guide in determining the types and amounts of clothing best suited for particular areas and seasons. 10-man and 5-man arctic tents, Yukon stoves, and arctic sleeping bags are provided for use by troops in the field. The tents are insulated and the stoves are designed to burn petroleum products, wood, or coal. Air duct heaters — 250,000 BTU or 450,000 BTU — are provided to heat large areas such as maintenance shelters or field hospital facilities. These heaters are either gasoline or electrically operated; both types are standard.

b. Subsistence.

(1) Subfreezing temperatures will involve changes in the amounts, types, storage, preparation, and distribution of foods. The body consumes food to counteract heat loss in cold weather, and corresponding increases in the caloric value of the ration up to as high as 5,300 calories are required for outdoor activity in cold weather. Rations must be of a type not susceptible to damage by freezing, or else heated transportation and storage space must be provided.

(2) Given free choice of unlimited amounts of foods of all types, the normal individual operating in extreme cold continues to consume proteins, carbohydrates, and fats in approximately the same ratio as in temperate climates. Fats and carbohydrates are quick energy-producing foods. An ounce of beef fat contains more calories than the same weight in sugar, but a greatly increased

intake of fat cannot be tolerated by the normal individual unless accompanied by a corresponding increase in lean meat.

(3) Outdoor activity in extreme cold results in body dehydration. Abnormal amounts of thirst-provoking foods should be avoided, both for comfort and logistical reasons. Hot drinks serve not only to quench thirst and correct fluid deficiency but also to transfer heat physically to the body. From the foregoing, it follows that:

(*a*) The normal ration must be augmented to the extent demanded by the severity of the cold weather.

(*b*) The augmentation should be in approximately standard proportions of proteins and fats, with a slightly larger proportion of sweets, fruit (particularly citrus) juices, soups, tea, and coffee.

(4) The ration augmentation required for the most extreme cold conditions will add approximately 30 percent to the weight and bulk of the standard ration. At least 10 percent augmentation should be planned for the mildest condition to be expected during northern winters.

c. POL Supplies.

(1) The increased amount of cross-country movement and extensive use of tracked vehicles with high fuel consumption characteristics must be considered when planning POL requirements for northern operations (FM 101–10). The normal type of military issue gasoline used in the temperate zones is satisfactory for use in extreme cold, although quick starting of cold engines is aided by using gasoline which has a higher than normal vapor pressure rating. Alcohol for addition to gasoline used in motors is absolutely required. Wherever possible, vehicle fuel tanks should be kept filled to decrease condensation. When gasoline is used for space heating, the requirements will increase as temperatures go down.

(2) The use of standby engine heaters, vehicle cab heaters, and the added percentage of time vehicles are operated in the lower gear ratios when operating cross-country in wet ground or deep snow add to the consumption rate of gasoline. Fuel oil used for space heating must be of the lightest grade obtainable (comparable to No. 2 grade diesel fuel) to insure that it remains fluid at temperatures below —40° F.

(3) Special cold weather type oils and greases which remain fluid in extreme cold are required for northern winter operations. These special oils and greases range

from extremely light oil for lubrication of instruments to wheel bearing grease. TM 9–207 authorizes and prescribes products for use in wheeled and track-laying vehicles which operate in northern climates where temperatures are anticipated to be consistently below 0° F. Nomenclature and specification number are given for each product. TM 9–207 also prescribes general instructions that apply to the processing of wheeled and track-laying vehicles for northern winter operations.

(4) The necessity for a complete change of all lubricants in vehicles and the changing of lubricants, hydraulic, and recoil fluids in artillery and other equipment at the approach of cold weather will require unusual amounts of this type of supplies. The low viscosity of motor oils used during cold weather results in higher consumption rates because of oil escaping past piston rings and oil seals. Lubrications and oil changes must be made more frequently.

(5) Permanent, Arctic Grade (—90) antifreeze compound will be used as prescribed in TM 9–207.

Section XI. SIGNAL

141. General

Signal personnel in northern operations carry out their normal combat, combat support, and service support missions. In addition to normal tactical communication networks, signal personnel may be required to operate long distance radio sets and, where there is scarcity of landmarks, electrical homing and direction-finding equipment. Highly trained technicians are required to cope with the many obstacles to electrical communication experienced in the North, such as magnetic disturbances and low ground conductivity. Wirelaying and maintenance crews will have to cope with surface waters in the summer and with ice and snow in the winter. Army aircraft, particularly helicopters, should be of great assistance to wirelaying and radio relay stations. Wire communications of any great magnitude are difficult to install and maintain. Greater reliance, therefore, must be placed on radio. Operations may be conducted over unusually long distances with great dispersion of units. This will usually require radio equipment over TOE authorization. Augmentation of communication equipment will be normal for northern operations. Communication support elements must be equipped with a cross-country, over-the-snow mobility comparable to the forces being supported. Special aspects of service support tasks are covered in chapter 5 (Signal Communications) of this manual.

Section XII. TRANSPORTATION

142. General

Transportation units can operate in subzero temperatures in much the same manner as in more temperate zones. However, individuals will require additional training in cold weather operations and in the increased maintenance requirements in northern areas. Provisions should be made for additional troop strength and equipment requirements. Vehicles of the track laying type are the best means for cross-country surface movement in northern regions. Units equipped with oversnow vehicles can operate during all seasons.

143. Ports

The ability to discharge cargo at northern ports is reduced by the limited facilities that are available. Rail and highway networks tend to limit the amount of cargo handled through any port. Where multiple port facilities are operated, personnel and equipment require augmentation. Environmental conditions limit the number of efficient working hours performed by terminal service personnel.

144. Rail

If available, rail transportation gives the capability of moving large tonnage of cargo and large numbers of personnel over long distances. Use of rail transportation in northern regions is greatly hampered by the heavy snowfall, snow slides, and extreme temperature changes. Additional equipment and operating personnel are required due to the need for separate snow removal crews. Train weights may be limited due to light-weight rail and low capacity trestles and bridges. Maintenance and wear on rail equipment increase, requiring more shop repair personnel. Rail track crews must be supplemented and trackage more frequently inspected since slides, glaciation, roadbed disturbances, and rail deficiencies often render the right-of-way impassable. In extreme temperatures or heavy snowfalls, rail movement may be augmented by tractor trains or cross-country tracked vehicles.

145. Highway

a. The absence of multiple railroads in the northern areas increases the utilization of highway networks and justifies a requirement for more transportation highway units. Consideration must be given to maintenance and recovery points, roadside rest stops, and messing facilities for driver personnel on long haul routes. Drivers should be thoroughly trained in accordance with

pertinent TM's and FM's. Wheeled vehicles are generally restricted to road movement and have little use in cross-country operations. Mandatory characteristics of any vehicle to be used in support of small units and individuals in the Far North during all seasons are mobility over muskeg and tundra and through brush and light timber and the ability to break trail in deep snow.

b. The regulation and control of highway traffic in Northern regions necessitates a well formulated and coordinated plan for implementing the maximum use of the highway network, particularly during the winter months. Highway regulation is essential because of the factors of movement of oversized and overweight equipment, convoy clearances, short daylight hours, winding, icy, narrow roadways, longer turnaround times, safety conditions, snowslides, avalanches, etc.

146. Air Transportation

Logistical and tactical transportation support requirements utilizing Air Force and Army air equipment for air-landed or air drop operations, in Northern regions follows the same general procedures as employed elsewhere. These northern areas generally devoid of adequate road and rail networks necessitates increased employment of aircraft for troop movements and logistical support missions. Use of aircraft (rotary and fixed wing) for deployment of troops, resupply, and evacuation during northern operations under both winter and summer conditions provides a flexible mode of transportation. Priorities must be established and prior planning accomplished far in advance of the actual employment of aircraft, due to reduced weight limitations and meteorological flying conditions.

CHAPTER 5

SIGNAL COMMUNICATIONS

Section I. GENERAL

147. Role

Military operations in northern latitudes may be characterized by the employment of independent task forces, usually beyond mutual supporting distance of each other. The lack of major land lines of communications, the necessity of relying upon air lines of communication, and the characteristic of great dispersal between forces means that primary reliance must be placed on radio as a means of signal communication. Operations over extended areas will require augmentation of radio equipment and personnel over the TOE authorization. When these factors are considered in conjunction with the extreme cold and deep snow, it can be seen that, under some circumstances, operations of isolated task forces will be practically impossible unless these forces are able to communicate with higher and adjacent units to arrange for support and supply.

148. General Effect of the Environment on Communications

a. Very low frequency radio communication is reliable in the northern latitudes of the world. High frequency transmission and reception, while capable of spanning the extended distances dictated by tactical requirements, are subject to interference by magnetic storms, aurora borealis, and ionospheric disturbances, which may completely black out reception for hours, or even days. Transmission and reception on frequencies in the very high frequency and higher bands is reliable under most conditions providing proper installation and operation procedures are followed.

b. The combined effects of terrain, cold, ice, dampness, and dust on communications equipment increase maintenance and supply problems to the extent that the full effort of operators and repair personnel is required to provide satisfactory communications.

149. Support of Signal Communications Activities by Army Aviation

Aircraft assist signal communication means in overcoming difficult terrain and climatic conditions by —

a. Air messenger service.

b. Wire laying.

c. Airborne radio relay.

d. Supply of critically needed items.

e. Placement and resupply of ground based radio retransmission stations.

f. Aerial photography.

Section II. RADIO COMMUNICATION

150. Propagation Methods

a. Radio communications in the northern latitudes offers no exceptional propagation difficulties is sufficient emphasis is placed on the selection and use of the proper frequencies and if the radio propagation graphs, charts, and prediction data presently available are fully utilized.

b. In order to appreciate the effect that atmospheric disturbances such as the aurora borealis (in the southern hemisphere, the aurora australis) can have on radio communication, it is necessary to understand the methods by which radio energy from a transmitter can reach the distant radio receiver.

c. The transmission of a radio signal from a transmitter to a receiver can occur essentially in one of two ways; that is, by a direct path between the antennas of the transmitter and the receiver or by a reflection from a layer in the upper atmosphere called the ionosphere. The radiated signal from the transmitter is divided into two main components, the ground wave and the sky wave. The ground wave travels along the surface of the earth and has a relatively short range. The sky wave travels upward into space at all angles up to the ionosphere. The ionosphere is an electrically charged region which exists at altitudes of 50 to 400 km above the earth and which has the property of reflecting or refracting radio signals back to earth just as a mirror reflects light. In this way long distance communication is possible; however, the ionosphere is variable and its action depends on the time of day or night, the season of the year, and the effect that radiation from the sun has on the reflective powers of the ionosphere. Also, it is selective in regard to frequency and the angle at which the radio waves arrive. Above a certain frequency (40 to 60 megacycles (mc)), the greater amount of the energy in radio waves passes through and is not reflected.

d. Tactical radio equipment, for the most part, depends on ground wave transmission, and therefore is limited to relatively short ranges. For communications in northern latitudes, radio equipment operating in the very low and low frequency bands (below 300 kilocycles (kc)) is particularly valuable since these bands experience fewer interruptions from aurorals. Complete antenna systems which do not rely on earth grounds must be used. Counterpoises constructed underneath the antenna, but insulated from the ground, increase the efficiency and reliability of low frequency radio circuits.

e. Tactical radio equipment operating in the so-called line-of-sight frequency band (30 mc and upwards—the frequency modulated series of tactical radio sets are included in this band) is not affected adversely by auroral activity. In fact, the greater ionization of the upper atmosphere which takes place during aurorals will, on occasion, increase the range of the tactical FM radios.

151. The Auroral Effect

The reflecting properties of the ionosphere are directly related to the position and radiation activity of the sun. The sun's bombardment of the earth's atmosphere coupled with strong magnetic activity concentrated near the poles causes a visual effect that is called the aurora borealis in northern latitudes. Ionization of atmospheric particles is increased, and radio waves reaching distant receiving points by means of sky wave propagation are reduced in intensity by increased absorption. This absorption becomes more pronounced during violent eruptions of the sun's surface which is visible in the form of sunspots. During such a period, a radio "blackout" may occur on circuits crossing or passing through the auroral zone. The greatest auroral activity occurs between 60° and 70° North latitude and occurs at intervals of 27 to 28 days. Signals from distant stations are usually much stronger prior to such periods. Monthly predictions of expected conditions are published by the National Bureau of Standards and are available to Division Signal Officers. It must be emphasized that "blackouts" occur throughout the high frequency spectrum and down to 25 kc and may last several days. In addition, high frequency sky wave transmissions are subject to sporadic blackouts which are, at present, unpredictable and erratic as to duration and coverage.

152. Atmospheric Static

a. In the medium frequency band (300 to 3,000 kc), very little continuous high level static is experienced in northern latitudes, but steady rushes of high level noise are common and signify an

auroral blackout on the frequency being monitored.

b. Flakes or pellets of highly charged snow are occasionally experienced in the North just as rain and sand static are encountered in many tropical and desert regions during periods of high winds. This phenomenon is commonly called precipitation static. Charged particles of snow driven against metal vehicles, antennas, and other objects usually discharge with a high pitched static roar that can blanket all frequencies for several hours at a time. While these phenomena are uncommon except in aircraft, they can take place just when communications are vital to some operations.

c. Antiprecipitation, static-proof antennas can be constructed by covering exposed portions of the antennas with layers of polystyrene tape and shellac to withstand breakdown voltages on the order of 30,000 to 40,000 volts. The value of such a system depends entirely on the station's isolation, since discharging particles on metal masts and other equipment near antiprecipitation receiving antennas can produce heavy static by radiation from the tiny sparks.

d. Very heavy shocks can be experienced from the ungrounded lead-in of antennas subjected to high winds or blowing snow even when the degree of audible static is not great.

153. Antennas and Grounds

a. Difficulties will be experienced is erecting antennas in the North. The frozen ground makes it difficult to drive the antenna ground, guy, and ground plate rods. Mountain pitons are considered excellent anchors for antenna guys in frozen earth, ice, or rocky soil. In addition, in extreme cold, ropes can be frozen to the ground and guys tied to these anchor ropes. Additional time must be allowed for these operations, and care must be exercised in handling lead-ins and metal masts since they become brittle in extreme cold. Vertical antennas are preferred for ground wave propagation in the high frequency band; but the use of fractional wave length whip antennas is not recommended, except for short distances.

b. All large horizontal antennas should be equipped with counterweights arranged so as to give before the wire or poles break from the pressure of ice or wind. Wet snow and sleet freezing to the antenna may be removed by jarring the supports.

c. Suitable grounds are difficult to obtain under conditions of extreme cold inasmuch as the frozen ground offers high electrical resistance. The permafrost which underlies much of the Far North offers as much obstruction to ground rods as solid reinforced concrete. Where it is possible to install a ground rod, the

rod should be driven as deeply as possible into the frozen earth or preferably through the ice of one of the lakes or rivers that abound in the North. In many instances it will be impracticable to secure a ground and it will be necessary to install a counterpoise. In no instance should more than one transmitter be connected to the same ground or counterpoise, nor should electrical noise-producing items such as direct current, battery-charging generators, or metal-walled huts be connected to receiver ground systems.

154. Effect of Extreme Cold on Battery Power Supplies

a. Although extreme cold impairs the operation of the electrical components which make up radio sets, it has its most serious effect on the dry type primary batteries which are used to power the small man-carried portable radios and many of the test instruments used to repair signal equipment. To minimize the effects of cold on dry type batteries, only those batteries designed for cold weather operations should be used for northern operations.

b. Batteries of all types show decreased power capacity at low temperatures, special designed cold weather batteries are more efficient. Batteries should be stored at supply points between temperature ranges of 10° to 35° F. Upon removal from storage, and prior to use, the batteries should be heated slowly to a temperature of 70° F. Warm batteries will give good results if used promptly upon exposure to cold. The conventional dry cell type battery loses efficiency rapidly at low temperatures and decreases in capacity as the temperature drops below 70° F. (The terminal voltage of the battery is not affected by cold — it is its capacity, life, or effectiveness to supply operating voltage over a period of time that is affected). At 0° F. it is 40 percent effective; at —10° F., 20 percent; and —30° F., only 8 percent effective.

c. Dry batteries, if kept warm at low ambient temperatures, will deliver satisfactory service life. Carrying of batteries inside clothing, or the use of insulated containers or heating devices, to provide a warm temperature for the battery are satisfactory as long as the battery temperature is not permitted to exceed 100° F. Battery vests designed for wear under outer clothing, consisting of temperate type batteries of flat cell construction should be used with man-packed radio sets during extreme cold. The useful life of the battery can also be extended if it is warmed up prior to the time it is placed in operation in the low ambient temperatures. Batteries which become inactive because of the cold may be reactivated by a thorough warming at a temperature below 100° F. A battery no longer serviceable in cold weather may be used indoors where the temperatures are warmer.

155. Electronic Warfare

The low temperatures, low visibilities, and the lack of ground lines of communication in the northern regions impose greater reliance upon radio type devices for command and control of ground combat forces. Radio navigation aids, so necessary because of the scarcity of landmarks, prevailing low visibility, and the long hours of darkness, are particularly sensitive to electronic warfare measures; this is especially true where alternate base stations are few and far between. On the other hand, the enemy must also rely upon electronic aids and a small electronic warfare unit properly employed can play a decisive role in northern latitudes.

156. Techniques and Expedients for Increasing Range and Reliability of Radios

a. Where radio communication is the primary means of signal communication, it is essential that the following techniques be followed at all times:

(1) Operators must be completely familiar with their set. They should read and understand the technical manual which is part of each radio.

(2) Operators should keep the radio set clean, dry, and as warm as possible.

(3) They should handle the set carefully. Radios that are exposed to extreme cold are particularly sensitive to jars, shocks, and rough handling.

(4) Preventive maintenance procedures take on added importance. Operators should be trained to set up a routine inspection and check procedure covering the following points:

(*a*) Plugs and jacks should be clean.
(*b*) Antenna connection should be tight. Insulators must be dry and clean; snow and ice removed.
(*c*) Power connections must be tight.
(*d*) Motors and fans should run freely.
(*e*) Knobs and controls should operate easily.
(*f*) Lubrication must be checked more frequently.
(*g*) Dry batteries must be fresh and kept warm.
(*h*) Operating spares must be on hand.
(*i*) Breath shields should be used on all microphones.

b. With equipment in good shape, lack of communication can be caused by the following:

(1) Excessive distance between sets.

(2) Bad intervening terrain, such as hills and mountains.

(3) Poor choice of location of one or both ends of the circuits.
(4) Poor choice of operating frequency for sky wave circuits.
(5) Poor choice of antenna.
(6) Not enough transmitter power.
(7) Excessive noise and interference.

c. The following techniques and expedients can be used to increase the range and reliability of radio circuits:

(1) Use the radiotelegraph (RATG) method of operation rather than the radiotelephone (RATEL).
(2) For tactical FM radios, elevate the antennas as high as possible either by siting the set on hills and mountains, using an elevated ground plane antenna, an improvised elevated half-wave antenna, or an improvised vertical half-rhombic antenna.
(3) Use remote control devices in order that stations may be sited in advantageous positions.
(4) Use intermediate voice or automatic retransmission stations for both FM or HF circuits. Radio sets using a retransmission device can be used as intermediate relay stations.

157. Radio Communications

a. Command radio circuits and nets must be established first and priority given to maintenance throughout the tactical operation. When an element moves out of ground wave range from its base of operations, retransmission points must be established or sky wave propagation will have to be depended upon when it is not possible to establish intermediate retransmission points. When it can be anticipated that circuit distances are so long as to preclude communications with equipment normally available, higher headquarters should be requested to furnish communications support. Situations may arise where radio communications will not meet full expectation. Alternate means, such as messenger service, must always be included in the signal communication plan.

b. The establishment of air-ground circuits is of major importance in all tactical operations in northern latitudes because of the dependence on aircraft for logistical support, observation, and messenger missions.

Section III. WIRE COMMUNICATION

158. Factors Affecting Wire Communication

Tactical wire communication has the same capabilities and

limitations in northern latitudes as in temperate zones. Due to the distances involved and the difficulty of overland movement, wire communications may be limited to telephones serving local installations. If long distance wire communications trunks (telephone, teletype, facsimile, and data transmission) are required, radio relay systems which can be integrated into the wire system should be considered because of relative ease of installation, economy of transport, and other logistic factors. Consideration must be given to the fact that more time is required to install and maintain field wire lines during periods of extreme cold and deep snow. Batteries which are used to operate field telephones and switchboards are subject to the same temperature limitations as those used to power the small portable tactical radio sets.

159. Special Considerations Applicable to Northern Latitudes

a. Aside from the logistical considerations, the most difficult task in providing wire communication is that of constructing and maintaining the necessary circuits. Field wire may be laid on the snow, but must be suitably marked to facilitate maintenance. Below the tree line, trees, if high enough, may be used to support the lines. Initial circuit layout should include consideration of wire and cable routes with respect to expected vehicular and oversnow traffic, so as to minimize the damage from tracklaying vehicles and skiing troops. Field wire lines should not be laid on ski trails which are used for troop movement; a separate communication trail should be broken and used. If the wire circuit is to remain in place during the warm season, particular care must be given to its placement through areas, such as lakes and muskeg, which may be impassable in summer and make maintenance impossible. Similar care should be taken to avoid locating wire lines in areas subject to snow and earth avalanches. Consideration must also be given to the effects of frostthrust and the shifting of ice masses.

b. Telephones, teletypewriters, facsimile equipment, wire carrier terminals, and telephone switchboards must be operated in heated shelters. Batteries and battery operated equipment should be kept warm even when low temperature batteries are used. Small field switchboards may be used outside of heated shelters, but their operation is difficult because of the bulky clothing that must be worn by the operators and the effects of cold upon the equipment. Microphones, telephones, and operators' sets must be provided with breath shields to prevent frost formation from disabling them. Further difficulties can be expected from switch malfunctioning and stiffening or breaking of associated cord and plug assemblies.

c. Grounds are extremely difficult to obtain in frozen soil.

Grounding of wire equipment is necessary; however, special cold weather ground stakes should be used and should penetrate the frozen surface of the earth 1 meter below the surface. It may be necessary to use special blasting devices to obtain suitable ground. Because of the difficulty of obtaining grounds and the high resistance of the soil, simplex telephone and teletypewriter circuits, which utilize a ground return to complete the circuit, should not be used.

d. Due to the difficulties of resupply and the necessity of limiting basic loads to the bare essentials, the communications officer must make every effort to recover all available wire for subsequent reuse. He must plan his circuits, so far as possible, to facilitate recovery, taking into account that wire or cable laid in or on the snow is extremely difficult to recover because of the melting, refreezing, and drifting action that takes place around the wire. The initial supply of wire, supplemented by limited resupply, may constitute the only source of field wire.

160. Techniques of Wire Construction in the North

a. Field wire is most conveniently laid from the dispenser MX/306/G. When these dispensers are used, communication can be maintained constantly to check the continuity of the circuits and to furnish a means of communication to the wire team. The dispenser can be attached to a standard packboard and the wire laid by a lineman on skis or snowshoes. When the distance is such as to preclude the use of linemen on foot and the terrain prevents the use of oversnow vehicles, wire can be laid from dispensers by Army aircraft.

b. Standard type oversnow vehicles equipped with reel units can be used to lay field wire or cable. If recovered field wire is available and has been properly serviced, it should be used in preference to wire from the dispensers, thus conserving the dispenser wire for critical situations. Serviced wire should be reloaded into dispensers whenever time and facilities permit. Field cable can be most effectively laid from drums mounted on reel units installed on the vehicle itself.

c. Army aircraft can be used to install field wire circuits between points difficult to reach by ground transport means. The wire is laid from the dispenser MX–306/G. Individual dispensers are connected prior to payout to provide the required length. The course over which the wire is to be laid must be suitably described to the pilot and the terminal points of the circuit marked by smoke, panels, or lights. In making plans for construction using this method, allow for a 50 percent slack factor, and consider the wire beyond recovery and extremely difficult to maintain.

d. Often the communications officer will find it necessary to use a combination of the previously mentioned techniques to install a single circuit. Lines to isolated relatively inaccessible detachments, such as weather stations, radar sites, and observation posts, may require the use of vehicle-towed cargo sleds or man-pulled 200-pound sleds to transport the additional amount of wire necessary to complete the circuit. Rockets and rifle grenades in conjunction with the dispenser can be used to carry field wire several hundred meters across ravines and crevasses.

e. It is extremely important, both from the viewpoint of conserving labor and considerably reducing required quantities of wire, to keep field wire and cables from being drifted over by the snow. Cables and wire that interconnect two or more units in a command can be covered with snow so deeply in a single day that the loss of many man-days in recovering or maintaining the circuits may result. This can be avoided by pulling the cable from under the snow after each snowfall and allowing it to rest on top of the snow or, better still, by using trees or cut poles to support the wire for overhead type construction. Make allowance for drifting snow in deciding on the height above ground at which to support the lines, and reduce the span distance to approximately 65 meters.

161. Tactical Employment of Field Wire Nets

Distances involved and the difficulty of supply will govern the extent to which field wire is employed. Every effort must be made to integrate the wire system with the radio system so that a complete electrical communication system is available for command and control.

Section IV. VISUAL COMMUNICATION

162. Factors Affecting Visual Communication

Visual means of communication are particularly effective in airground operation, when atmospheric conditions or security requirements preclude the use of radio, and in mountainous country where the extreme ruggedness of terrain prevents the laying of wire but affords line-of-sight for siting of visual stations. Signal lamps may be used when the situation permits. Blowing snow, haze, ice, fog, and other atmospheric conditions may affect the range and reliability of visual signalling in the northern latitudes. Security requirements for visual means of communication are the same in the North as in temperate zones.

163. Panel Communications

The standard panels are satisfactory for air-ground signalling

when displayed against a background of snow. It must be recognized that blowing snow can obliterate panels in a matter of seconds.

164. Pyrotechnics

a. Colored smokes most easily seen against snow covered backgrounds are, in order, red, violet, green, and yellow.

b. Smoke grenades; mortar and artillery marking rounds of the base ejection type will tend to be smothered by deep snow. Use of a time fuze to obtain air bursts will facilitate location of marking rounds. In using white phosphorus projectiles, the white phosphorus will tend to be smothered, and in addition, particles of phosphorus will remain to contaminate the area.

Section V. MESSENGER

165. Special Factors to be Considered

Communication by messenger is frequently the only means available to units. In the uncharted areas of the northern latitudes of the world, the ability of messengers to find their way takes on added importance. Messengers should be good skiers, resourceful, and familiar with northern peculiarities. Messengers should always be dispatched in pairs.

166. Aircraft Messenger Service

Messenger service should be scheduled between units and should, if possible, be integrated with the aerial resupply missions.

167. Vehicular Messenger Service

a. Vehicles may be employed to maintain messenger communications between units when the conditions of time, terrain, and distance permit. At best, surface transportation is slow, subject to interception by ground ambush parties, and uneconomical with respect to fuel and equipment.

b. It is essential that all vehicles utilized for messenger service over infrequently used routes be equipped with radio, emergency equipment, snowshoes, heating apparatus, and simple navigational equipment. It is likewise essential that messengers be trained in radio operation and ground navigation. When security permits, the vehicle should be kept in continuous communication with its headquarters. The unit to which the vehicle is destined should be informed by enciphered radio message as to the time of departure and expected time of arrival.

Section VI. PHOTOGRAPHY

168. Operation

Under conditions of extreme cold, camera mechanisms tend to operate more slowly and film emulsions acquire different sensitivity. Cameras, and other equipment with optical lenses, must never be brought into heated rooms without careful, slow heating. Exposures on open snow are usually adjusted for the light intensity in the shadows to give best results. Processing is complicated by insolubility, precipitation, and lowered activity of chemicals at low temperature. Further information relative to techniques of photography in northern latitudes is contained in Sig TB's.

169. Aerial Photography

Aerial photos of snow-covered terrain will not disclose as much terrain detail as one of the same area barren of snow; on the other hand, trails and tracks in snow show up in great detail on aerial photographs and are excellent sources of information.

Section VII. MAINTENANCE AND CARE OF EQUIPMENT

170. General

Standard types of signal communication equipment can be used at very low temperatures with satisfactory results if proper precautions are taken and the equipment is properly winterized. Provision must be made in the operation plan to include the special maintenance requirements necessitated by operations in extreme cold. As a general rule, signal communication equipment should be installed and operated in a warm shelter. Warm shelters are an absolute necessity for maintenance personnel. The general principle of keeping equipment warm and dry, in addition to following winterization instructions closely, will insure the best possible performance of signal communication equipment. Further information relative to maintenance of signal equipment in northern latitudes is contained in Sig TB's.

171. Storage Batteries

When used in subzero temperatures, storage batteries should always be maintained in a fully charged condition, or recharged frequently, in order to make the maximum capacity available. Frozen batteries should never be charged but should be warmed until the electrolyte melts before charging is started. Charging batteries at temperatures below —20° F. is not advisable. High charging voltage should be avoided because of the excessive

gassing that occurs, which reduces the efficiency of the charging process. Operators of signal equipment which is powered by the vehicular battery must be impressed with the importance of maintaining the battery at the highest possible efficiency.

172. Fuels and Lubricants

a. Freezing of fuel lines and fuel strainer bowls, caused by the presence of water in fuel and fuel tanks, can cause much trouble. Every precaution should be taken to prevent the entrance of snow or ice into fuel cans and fuel tanks. Fuel containers must be kept tightly closed when not in use to prevent "breathing" of air which will condense and form moisture in the containers. Fuel tanks should be filled prior to shutdown for the same reason. Denatured alcohol should be added to gasoline in the proportion of 1 quart to a 30–50 gallon tank to minimize the possibility of moisture freezing in fuel lines.

b. Gasoline, antifreeze, and lubricating oil cans should be carefully marked as to their contents and should be segregated to eliminate the possibility of pouring a 5-gallon drum of antifreeze into a gas tank.

c. Lubricants used in temperate climates are sometimes unsatisfactory for use at low-temperatures. Such lubricants should be completely replaced by suitable low temperature greases or oil. Where specified in lubrication orders, low temperature lubricants are used to replace the normal temperature lubricant. In all cases of lubrication for northern operations, too much grease or oil may seriously hamper the normal movement of bearing surfaces. In some cases equipment, such as cameras and the generators of manual telephones, functions better at extremely low temperatures if all lubricants are removed and the bearing surfaces left dry; but prolonged use under this condition results in undue wear of parts.

173. Rubber and Rubber-Like Compounds

Rubber and rubber-like compounds become increasingly stiff and brittle as their temperature is lowered. When cold, cordage should be flexed slowly and carefully in order to minimize breakage. Power cables and coaxial cable transmission lines should be warmed before they are laid in the open. Frequent failure of cables of these types, and of field wire, may be expected if it is necessary to recover and rereel them during extreme cold. Increased requirements for replacements should be anticipated. Where possible, contact of rubber items with fuels and lubricants should be avoided. Where feasible, rubber items should be warmed before flexing.

174. Radio Receivers and Transmitters

Upon exposure to extreme cold, radio receivers and transmitters adjusted for operation in a relatively warm place may exhibit, in their frequency determining circuits, changes of sufficient magnitude to impair their operation. Low battery voltage will also have a detrimental effect on frequency determining circuits. All radio operators must be trained to make frequent checks for proper frequency. It is particularly important that the operators at the radio net control stations be alert to this condition and that they require the secondary stations of the net adjustments to keep them on frequency.

175. Microphones

Moisture from the breath freezes on the buttons and perforated cover plates of microphones, causing the instrument (telephone, radio, etc.) to become inoperative. Standard microphone covers are available and should be used in northern latitudes during periods of extreme cold. If the standard cover is not available, a cover can be improvised by using a thin cellophane or cloth membrane.

176. Mechanical Malfunctions

Plugs, jacks, keys, shafts, bearings, dials, switches, and camera shutters are subject to malfunctioning caused by the differential contraction of metal parts in extreme cold. The result is binding, difficulty in turning and adjusting, or complete locking of the part. In addition to the trouble caused by differential contraction, moisture condensation which freezes in such assemblies will also render them inoperative. Moisture condensation caused by localized heating may freeze in subassemblies during shutdown periods and may render them difficult to operate, or even inoperative.

177. Breathing and Sweating

Any equipment which generates heat during operation will "breathe" or draw in cold air as the equipment itself cools. If such heated equipment is brought into contact with extremely cold air, the glass, plastic, and ceramic parts may break. "Sweating" is the reverse of the process described above. If cold equipment is brought into contact with warm air, the moisture in the air will condense on the equipment and will subsequently freeze when the equipment is brought into the cold again. Cold equipment should be wrapped in a blanket or parka before being brought into a heated shelter.

178. Wire Insulation

Extreme care must be taken in handling insulated wire and cable at subzero temperatures, inasmuch as the insulation tends to become stiff and brittle and liable to cracking. Insulation is especially vulnerable at such points as field wire ties and splices. Rubber and plastic covered cables should be warmed before bending so as to minimize the possibility of breaking the insulation. Coaxial cable is particularly critical because the inner plastic insulation may crack. Standard friction and rubber tape lose their adhesiveness when subjected to extreme cold. Splicing of field wire and cables is a problem because the hands must be protected by mittens or gloves which restrict handling. Special cold-weather type electrical insulating tape is available and may be used without prewarming.

CHAPTER 6

TRAINING

Section I. GENERAL

179. Scope of Training

a. Units selected for employment in the North should have completed normal individual and unit training prior to beginning cold weather training.

b. Training falls into two categories — summer training and winter training. Because of the special factors introduced by the northern environment, training differs more widely from that of temperate zones. It demands higher standards of physical fitness, and emphasis is placed on conducting as much training as possible out-of-doors. Training to familiarize troops with special equipment must precede unit training in the application of northern techniques to tactical principles. Preliminary training in using special equipment can be taught without the environmental factors of snow and cold, thus gaining time for technical and tactical training. In all training, emphasis should be placed on operations conducted during hours of darkness. Training in summer is the same as in temperate zones except for environmental conditions.

180. Training Areas

Care must be taken in the selection of suitable training areas to insure that all possible conditions of climate and terrain, likely to be encountered during subsequent operations, are experienced during training.

181. Instructor Requirement

Provision of qualified instructors is a critical problem in preparing a force for northern operations. Minimum requirements are one officer for each company sized unit and two noncommissioned officers for each platoon or equivalent unit.

182. Training of Qualified Instructors

A preliminary course for unit instructors must be conducted before the commencement of northern training. This course must be supervised by instructors who are thoroughly experienced in the various techniques peculiar to northern operations. Practical field experience should be provided unit instructors prior to starting the unit training program.

183. Training Objective

To train individuals and units to accomplish their combat mission under all conditions of weather, climate, and terrain encountered in northern operations. The standards of training must be high since units will often be operating in small groups. Leadership by small unit commanders and individual initiative must be developed and stressed.

Section II. WINTER TRAINING

184. General

The basic requirements for training in Northern Operations are the same in all seasons. Toughness, resourcefulness, initiative, and ability to live and operate in the field are required of each individual. In most respects troops trained during the winter are capable of conducting operations during any other season.

185. Training Period

Winter training is a task requiring a well-coordinated program and a competent instructional and administrative staff. For units that have completed advanced unit training, a training period of fourteen weeks is desirable. Training for northern winter operations falls into the following phases (for technical units, some adjustment may be necessary between the indoctrination and specialist training) —

a.	Indoctrination training (common to all arms)	9 weeks
b.	Specialist training	1½ weeks
c.	Unit training	1½ weeks
d.	Combined arms training	2 weeks

A typical program for indoctrination training together with appropriate subject schedules for a unit is shown in appendix II.

186. Indoctrination Training

Individual and small unit indoctrination training should cover clothing, small unit living and cooking, weapons training, dis-

mounted movement, snowshoe and ski training, map reading and navigation, field fortifications, camouflage, and first aid and hygiene, as outlined in FM 31–70.

187. Specialized Training

a. Driving and Maintenance. The highest standards of driving and maintenance must be maintained. To overcome the obstacles encountered during winter operations, close supervision by officers and noncommissioned officers is required to insure that these standards are maintained. Special training is required in the use of winterized equipment, engine heaters, and other special devices; care of batteries; and treatment of fuel to avoid condensation (TM 9–207, TM 9–8662, and TM 9–273). Extensive practice in driving under the more difficult conditions of terrain, snow, and ice, and in recovery of vehicles is essential. Drivers must be trained to make on-the-spot emergency repairs and in the use of field expedients.

b. Communications. Commanders should be aware of the environmental factors that affect communications and the necessary measures to overcome them. All communications personnel must learn the special techniques necessary to prepare and maintain their equipment and communication nets at operational efficiency under all conditions.

c. Equipment Repair.

(1) The conditions of northern warfare cause a high rate of damage to all equipment. Unit mechanics will require training for repair work under these conditions and, either a higher proportion of mechanics than normal are provided, or special courses in field equipment repair must be organized for selected enlisted men.

(2) Individuals should be trained to make minor repairs to the special items of equipment (sleds, skis, and snowshoes) that are issued for these areas.

d. Navigators. In certain regions and for certain types of operation, the force may require personnel trained in celestial navigation using a theodolite or a sextant.

e. CBR Training. Training for operations under CBR conditions is best accomplished by integration of CBR situations and procedures into the normal training routine. Since CBR protection procedures will vary in extreme cold from those used in temperate climates, individuals must relearn masking, first aid, decontamination, operating in toxic atmosphere or on contaminated ground, and CBR defense in general as modified by extreme cold conditions.

f. Other Specialized Training. It is to be noted (app. II) that

special attention must be given to the training of radio operators, vehicle drivers, weapons crews, medical and engineering personnel, and specialists of all other supporting arms and services. All specialists should have an indoctrination course. This training would provide for the necessary knowledge and proficiency in common techniques such as: use of clothing and equipment and the ability to move, live, and operate under northern conditions. The remainder of the training period must provide for instruction in those special techniques and functions peculiar to their specialty.

188. Officer and Senior Noncommissioned Officer Training

a. Leadership. The qualities of leadership demanded of officers and noncommissioned officers by northern operations are far higher than those normally required for any other type of warfare. Fear of the area of operations must be overcome, and leaders must be impressed with the exacting nature of their responsibilities in this respect.

b. Land Navigation. All officers and senior noncommissioned officers must be proficient in dead-reckoning navigation. They should thoroughly understand the use of the magnetic compass in the North since it is the most common direction-finding instrument used by the individual and small unit.

c. Elementary Meteorology. Officers must be able to interpret meteorological reports since weather will be a major influence in the planning and execution of operations.

d. Bearing Capacity of Ice. Each officer and noncommissioned officer should be thoroughly acquainted with the various factors affecting the strength of ice and the rules or calculations necessary for determination of its bearing capacity.

189. Training Emphasis

a. Correct procedures must be emphasized at all times during training to insure that the basic techniques of northern operations are thoroughly mastered and correctly applied. Even the very minor errors must be pointed out and the proper corrective action demanded. If men are properly trained during the training cycle, they will continue to perform the necessary tasks when confronted with the extreme conditions found in the area of northern operations. The troops must be impressed with the fact that their job is still "success in combat" and not one of survival.

b. Some of the more common areas requiring emphasis are:

(1) Keeping the body clean.

(2) Preventing dehydration, constipation, and overheating.

(3) Proper care of weapons and equipment.
(4) Taking positive action and improvising means of maintaining mobility when confronted with obstacles or equipment failure.
(5) Proper care of feet.
(6) Importance of hot food.
(7) Troop safety to include carbon monoxide, fire hazards, and cold weather injury.
(8) Proper camouflage discipline.
(9) Preparation of sleeping areas.
(10) Movement at night or during conditions of low visibility.
(11) Importance of detailed, simple, and flexible plans.
(12) Land navigation.
(13) Rapid deployment and cross-country movement.
(14) Route selection.
(15) Trailbreaking.
(16) Using the terrain and weather to advantage.
(17) Proper employment of weapons.
(18) First aid and self-aid techniques.

Section III. TRAINING — OTHER SEASONS

190. Training Period

a. The period of summer training required for northern operations can be six weeks. Of this, three weeks are required for basic indoctrination and small unit training and three weeks for unit and combined training. Engineers require an additional period of at least two weeks for specialist training.

b. The basic program suggested for winter training is suitable if adjusted by the elimination of those items peculiar to winter conditions and the substitution of those required for summer. The period to be allotted to inland waterways navigation is dependent on the standard of training of troops on arrival and must be adjusted accordingly.

c. The number of instructors required is the same as for winter training.

Section IV. HINTS FOR INSTRUCTORS

191. Avoiding Fear of the North

Most troops have an exaggerated conception of the danger, discomfort, and loneliness of the North. Avoid the natural tendency to enlarge upon such environmental hazards. Instructors must use every means in their power to insure that all men

obtain a balanced perspective of northern operations at the earliest possible moment.

192. Training Environment

One of the principal objects of training is to accustom troops to the cold and living in the field. As far as possible, all work should be outdoors, and the training schedule developed with this goal in view.

193. Supervision

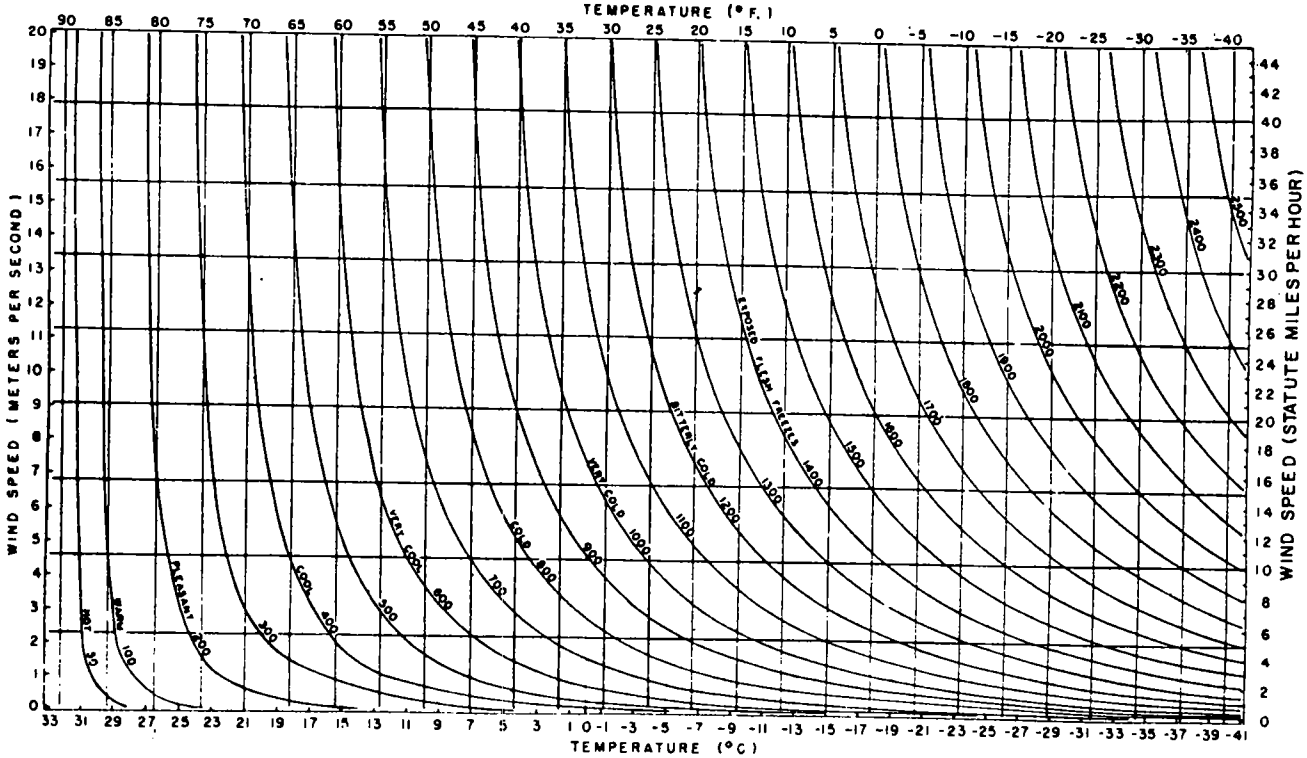
a. At the beginning of training, instruct troops in the "Buddy" system for detecting frostbite, under which each man periodically inspects the face and hands of his neighbor. In spite of this, it is necessary, particularly during the early stages of training, for instructors to check troops frequently for frostbite, frozen feet or hands, and overheating.

b. Before commencing a march, instructors must check to insure that each man has mittens, sunglasses, and other essential items of clothing and equipment. Particular care must be taken to check all squad equipment, including tents, stoves, and fuel, and to insure that men are not wearing too much clothing before a march commences. One of the greatest dangers is overheating and perspiring.

c. Frequent halts should be of short duration (25 minutes marching and 5 minute breaks) depending on the difficulties presented by the terrain and the condition of the men. Men should never be allowed to become cold when resting.

d. On strenuous marches or in bad weather, a vigilant watch must be maintained for signs of exhaustion.

e. When establishing camp, leaders should make certain that no man who is damp with perspiration or who has wet feet is immediately placed on sentry or similar duty before drying off or changing socks. A continual watch must be maintained to insure that men do not endanger themselves by fire or expose themselves to carbon monoxide fumes.



SOURCE. Based on nomogram originally prepared by the Climatic Research Unit Office Of The Quartermaster General, January 1943.

Figure 24. Windchill nomograph

APPENDIX I

REFERENCES

AR 40–501	Standards of Medical Fitness.
AR 220–50	Field Organizations: Regiments; General Provisions.
AR 320–5	Dictionary of U.S. Army Terms.
AR 320–50	Authorized Abbreviations and Brevity Codes.
AR 600–20	Army Command Policy and Procedures.
FM 1–100	Army Aviation.
FM 3–5	Tactics and Techniques of Chemical, Biological, and Radiological Warfare.
FM–5–15	Field Fortifications.
FM 5–20	Camouflage, Basic Principles and Field Camouflage.
(S) FM 5–26	Employment of Atomic Demolition Munition (ADM) (U).
FM 5–29	Passage of Mass Obstacles.
FM 5–31	Use and Installation of Booby Traps.
FM 7–11	Rifle Company, Infantry, Airborne Infantry, and Mechanized Infantry.
FM 7–15	Infantry, Airborne Infantry, and Mechanized Infantry Rifle Platoons and Squads.
FM 7–20	Infantry, Airborne Infantry, and Mechanized Infantry Battalions.
FM 7–30	Infantry, Airborne Infantry, and Mechanized Division Brigades.
FM 8–35	Transportation of the Sick and Wounded.
FM 17–1	Armor Operations, Small Units.
FM 17–15	Tank Units, Platoon, Company and Battalion.
FM 17–30	The Armored Division Brigade.
FM 17–36	Armored Cavalry Platoon and Troop, Air Cavalry Troop and Divisional Armored Cavalry Squadron.
FM 21–5	Military Training.
FM 21–6	Techniques of Military Instruction.
FM 21–10	Military Sanitation.
FM 21–11	First Aid for Soldiers.

FM 21–26	Map Reading.
FM 21–30	Military Symbols.
FM 21–40	Small Unit Procedures in Nuclear, Biological, and Chemical Warfare.
FM 21–41	Soldiers Handbook for Nuclear, Biological, and Chemical Warfare.
FM 21–48	Training Exercises, and Integrated Training in Chemical Biological and Nuclear Warfare.
FM 24–18	Field Radio Techniques.
FM 24–20	Field Wire and Field Cable Techniques.
FM 25–10	Motor Transportation Operations.
FM 30–5	Combat Intelligence.
FM 30–7	Combat Intelligence Battle Group, Combat Command, and Smaller Units.
FM 31–12	Army Forces in Amphibious Operations
FM 31–30	Jungle Operations.
FM 31–70	Basic Cold Weather Manual.
FM 31–72	Mountain Operations.
FM 41–10	Civil Affairs Operations.
FM 44–1	U.S. Army Air Defense Employment
FM 54–2	Division Logistics and the Support Command.
FM 57–10	Army Forces in Joint Airborne Operations.
FM 57–35	Airmobile Operations.
FM 61–100	The Division.
(S) FM 100–1	Doctrinal Guidance (U).
FM 100–5	Field Service Regulations; Operations.
FM 100–10	Field Service Regulations; Administration.
FM 101–5	Staff Officers' Field Manual; Staff Organization and Procedure.
FM 101–10	Staff Officers' Field Manual; Organization, Technical, and Logistical Data.
FM 101–31	Staff Officers' Field Manual, Nuclear Weapons Employment.
TM 3–215	Military Chemistry and Chemical Agents.
TM 3–300	Ground Chemical Munitions.
TM 3–366	Flamethrower and Fire Bomb Fuels.
TM 3–376	M2A1 Portable Flamethrower.
TM 3–522–15	Mask, Protective, Field, M9 and M9A1.
TM 5–250	Roads and Airfields.
TM 5–251	Army Airfields and Heliports.
TM 5–315	Fire Protection by Troop Organization in Theater of Operation.
TM 5–349	Arctic Construction.
TM 8–501	Nutrition.

TM 9–207	Operation and Maintenance of Ordnance Materiel in Extreme Cold Weather (0° to —65° F.).
TM 9–273	Lubrication of Ordnance Materiel.
TM 9–1300–203	Ammunition, Field Artillery.
TM 9–1900	Ammunition, General.
TM 9–1950	Rockets.
TM 9–8662	Fuel-Burning Heaters for Winterization Equipment.
TM 10–275	Principles and Utilization of Cold Weather Clothing and Sleeping Equipment.
TM 55–404	Fundamentals of Army Airplane Maintenance.
TM 743–200–1	Storage and Materials Handling.
Pam 108–1	Index of Army Motion Pictures, Filmstrips, Slides, and Phono-Recordings.
Pam 310–1	Military Publications—Index of Administrative Publications (Army Regulations, Special Regulations, Circulars, Pamphlets, Commercial Traffic Bulletins, Military Traffic Management Bulletins, Joint Chiefs of Staff Publications, General Orders, and Bulletins).
Pam 310–2	Military Publications—Index of Blank Forms.
Pam 310–3	Military Publications—Index of Training Publications (Field Manuals, Reserve Officers' Training Corps Manuals, Training Circulars, Army Training Programs, Army Subject Schedules, Army Training Tests, War Department and Department of the Army Posters, and Firing Tables and Trajectory Charts).
Pam 310–4	Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
Pam 310–5	Military Publications—Index of Graphic Training Aids and Devices.
Pam 310–7	Military Publications—Index of Tables of Organization and Equipment, Type Tables of Distribution, and Tables of Allowances.
TB Sig 189	Cold Weather Photography.
TB Sig 239	Maintenance Information for New Series Radio Sets.
TB Sig 271	Lubrication of Tactical Teletypewriter Equipment, Teletypewriters, and Reperforator Transmitters.
TB Sig 346	Maintenance of Radiac Equipment.

APPENDIX II

SUGGESTED TRAINING PROGRAM FOR WINTER INDOCTRINATION

Item	Subject	Code letter	Total hours	Weeks									Remarks
				Basic phase				Advanced phase					
				1	2	3	4	5	6	7	8	9	
1	Living in the field	LF	24	4	12	8	...	...	...	...	...	...	(1) Additional training in skiing and snowshoeing will be received in connection with tactical problems.
2	Clothing	C	2	2	...	...	...	...	...	...	...	...	
3	First aid and hygiene .	FA	8	3	3	2	...	...	...	...	...	...	
4	Equipment	E	15	10	5	...	...	...	...	...	...	...	
5	Camouflage	CF	6	2	4	...	...	...	...	...	...	...	
6	Snowshoeing (1)	SN	8	4	...	4	...	...	...	...	...	...	
7	March discipline	M	10	2	...	4	4	...	...	...	...	...	
8	Map reading and land-navigation.	MR	12	1	3	4	4	...	...	...	...	...	
9	Weapons	W	4	2	...	...	2	...	...	...	...	...	
10	Road construction	RC	4	...	...	...	...	...	...	...	...	4	
11	Small unit training	ST	56	...	4	...	4	17	31	...	...	...	
12	Skiing (1)	SK	72	9	8	17	17	21	...	...	...	...	
13	Unit training and tactics	UT	72	...	...	...	...	1	8	31	11	21	
14	Field fortifications	FD	8	...	...	...	8	...	...	...	...	...	
15	Battalion problems	BP	31	...	...	...	...	...	...	...	16	15	
16	Tests and competition	TC	20	...	...	...	...	...	...	8	12	...	
17	Care and cleaning of equipment.	CE	8	1	1	1	1	1	1	1	1	...	
		CT	36	4	4	4	4	4	4	4	4	4	
18	Commander's time												
	Totals	...	396	44	44	44	44	44	44	44	44	44	

LIVING IN THE FIELD
Subject Schedule

CODE LF
Total periods 24

Periods	Type of instruction	Subject	References and remarks
LF 1	Conference	Living in a cold climate-utilizing the help offered by nature.	A general conference on all aspects, stressing the need for self-reliance and ways to get along in outdoor living. FM 31–70.
LF 2	Conference	Demonstration of field rations. Tips on cooking field rations, melting snow, and keeping water overnight.	FM 31–70 Films FS 10–140, "Individual Cooking in the Arctic."
LF 3	Conference	Camp routine: 1. Organizing the work of tent teams. 2. Building temporary ski racks and latrines.	FM 31–70 TF 31–2138, "Subarctic Winter Bivouacing," (30 min.).
LF 4	Conference	Camp security	FM 31–70, FM 31–71.
LF 5–7	Demonstration	Practical forestry: 1. Handling and caring for tools. 2. Cutting and trimming trees. 3. Temporary shelters. 4. Types of camp fires and safety precautions.	FM 31–70.
LF 8–9	Practical work	Preparing a meal of field rations	FM 31–70.
LF 10–13	Demonstration and practical work.	Winter bivouac	Practical daytime training. FM 31–70.

LIVING IN THE FIELD—Continued
Subject Schedule

CODE LF
Total periods 24

Periods	Type of instruction	Subject	References and remarks
LF 14–15	Demonstration	Sound and light demonstration	Point out following: 1. Sounds caused by man and units while skiing and snowshoeing. 2. Sounds of various types of vehicles. 3. Careless handling of lights, cigarettes, flashlights, opening of tent doors.
LF 16–24	Practical work	Overnight bivouac and security. Breaking camp during darkness.	FM 31–70. FM 31–71.

CLOTHING
Subject Schedule

CODE C
Total periods 2

Periods	Type of instruction	Subject	References and remarks
C 1	Conference	Principles of cold weather clothing and foot gear, fitting and adjustment. Use and care of sleeping bag.	TM 10–275, FM 31–70. Film "Cold Weather Clothing," GF 10–21, running time 14 min.
C 2	Conference	Supply economy in winter conditions.	

FIRST AID HYGIENE
Subject Schedule

CODE FA
Total periods 8

Periods	Type of instruction	Subject	References and remarks
FA 1–2	Conference	Discussion of first aid measures necessary to prevent frostbite, trenchfoot, carbon monoxide poisoning, and snow blindness.	FM 21–11, FM 31–70. Film 8–1690, "General Effects of Cold on Man," (running time 12 min). Film FB 8–180, "Trenchfoot," (running time 14 min).
FA 3	Conference	Evacuation of casualties under winter conditions	FM 31–70, FM 8–35.
FA 4–6	Demonstration	Evacuation of casualt.es by sleds, improvised sleds, ski litters, tracked vehicles, and cargo sleds. Proper handling and transpoft of a casualty.	FM 31–70.
FA 7–8	Practical work	Evacuation of casualties in defense; all normal and improvised means of transportation to be used.	FM 31–70.

EQUIPMENT
Subject Schedule

CODE E
Total periods 15

Periods	Type of instruction	Subject	References and remarks
E 1–2	Conference and practical work.	Fitting and adjustment of skis, bindings, and poles	FM 31–70.
E 3–4	Practical work	Fitting and adjustment of snowshoe bindings. Emergency bindings. Repair of bindings.	FM 31–70.
E 5	Practical work	Packing, adjustment, and carrying of rucksack and packboard.	FM 21–15, FM 31–70, TM 10–275.
E 6–7	Practical work	Pitching, striking, and packing of tent, arctic, 10-man; and tent hexagonal, lightweight.	FM 20–15; FM 31–70.
E 8	Practical work	Stoves, Yukon and one burner. Coleman lantern. Filling and testing.	FM 31–70, TM 10–735.
E 9–10	Demonstration and practical work.	Loading and lashing of sled, boat type, plastic, 200 lbs., and sled, 1-ton cargo.	FM 31–70.
E 11–14	Practical work	Loading of tentage, weapons, and basic load of ammunition on sleds. Pulling exercise.	Instructor's notes.
E 15	Demonstration	Basic principles of cargo carrying track vehicles.	FM 31–70, TM 9–772, TM 9–500.

CAMOUFLAGE
Subject Schedule

CODE CF
Total periods 6

Periods	Type of instruction	Subject	References and remarks
CF 1–2	Conference and demonstration.	Camouflage in winter	FM 31–70.
CF 3–4	Practical work	Individual camouflage: 1. Men. 2. Weapons. 3. Positions.	FM 31–70. TM 5–349.
CF 5–6	Practical work	Group camouflage: 1. Crew served weapons. 2. Tents. 3. Vehicles.	FM 31–70. TM 5–349.

SNOWSHOEING
Subject Schedule

CODE SN
Total periods 8

Periods	Type of instruction	Subject	References and remarks
SN 1–4	Demonstration and practical work.	Snowshoeing techniques: 1. On level ground. 2. Over rolling terrain. 3. Ascending and descending. 4. Overcoming obstacles.	FM 31–70.
SN 5–8	Practical work	Snowshoe march 5 miles	FM 31–70. Individual weapons are carried.

MARCH DISCIPLINE
Subject Schedule

CODE M
Total periods 10

Periods	Type of instruction	Subject	References and remarks
M 1	Conference	Winter marches and security	Stress overheating, excessive food and drink, security formations, control, and discipline. TF 7-1550, "Combat in Deep Snow and Extreme Cold," running time 21 min. FM 31-70.
M 2	Conference	Trailbreaking and track discipline	Trailbreaking, halts and rest periods, track patrols, obliteration, route selection, reading of tracks. FM 31-70, FM 31-71.
M 3-6	Practical work	Trailbreaking, reading and obliteration of tracks, deceiving tracks.	FM 31-70. FM 31-71.
M 7-10	Practical work	Cross-country march, march security, trailbreaking.	FM 31-70, FM 31-71.

MAP READING AND LAND NAVIGATION
Subject Schedule

CODE MR
Total periods 12

Periods	Type of instruction	Subject	References and remarks
MR 1	Conference	Basic navigation — without compass	TF 5–1790, "Basic Map Reading," Part IV, running time 21 min.
MR 2	Conference	Basic navigation — with compass	TF 5–1791, "Basic Map Reading," Part III, running time 33 min.
M 3–4	Conference and practical work.	Navigation in the winter	FM 21–26.
		Dead reckoning, navigation log, pacing by using snowshoes and skis. Use of rope for measuring distances.	FM 31–70.
			FM 31–71.
MR 5–8	Practical work	Daytime compass course	FM 31–70.
MR 9–12	Practical work	Night compass course	FM 31–70.

WEAPONS
Subject Schedule

CODE W
Total periods 4

Periods	Type of instruction	Subject	References and remarks
W 1	Conference and practical work.	Firing positions in winter	FM 31–70. MF 31–7878, "Firing Positions in Winter," running time 13 min.
W 2–4	Practical work	Firing	FM 31–70. Familiarization known distance range firing or trainfire. Concurrent training should include individual firing positions in snow; use of weapon supports of various types; and effect of small arms in deep snow, frozen ground, and against icecrete. Training should include emphasis on peculiarities of ammunition and weapons functioning in Northern climes.

ROAD CONSTRUCTION
Subject Schedule

CODE RC
Total periods 4

Periods	Type of instruction	Subject	References and remarks
RC 1	Conference	Planning, construction, and maintenance of winter roads.	FM 5–10, FM 31–70, TM 5–349. TF 5–2371, "Field Engineering in the Subarctic (Winter Roads)."
RC 2	Demonstration	Organization, equipment, and function of road construction detail: 1. Detail varying from one rifle squad up to one rifle platoon; dozer operator and mechanic. 2. Tracked carriers, sleds, pioneer tools, and special equipment required. 3. Techniques of road construction. 4. Techniques used to reinforce ice and unfrozen ground. 5. Techniques used to maintain winter roads.	
RC 3–4	Practical work	Route selection, construction, and marking of winter roads (to include construction of reinforcements and turnouts).	FM 5–10, FM 31–70, TM 5–349.

SMALL UNIT TRAINING
Subject Schedule

CODE ST
Total periods 56

Periods	Type of instruction	Subject	References and remarks
ST 1–4	Conference, demonstration, and practical work.	Combat techniques: 1. Firing positions. 2. Use of ski poles, skis, and snowshoes for support of the weapons.	FM 31–70 TF 7–2397, "Individual Fighting Techniques on Snow" (23 min.).
ST 5–8	Demonstration and practical work.	Interpretation of ski and snowshoe tracks on the field. Use of ski and snowshoe tracks to deceive the enemy.	FM 31–70 FM 31–71
ST 9–12	Practical work	Daytime patrolling: 1. On the route to the objective. 2. Activity in the objective area. 3. Return.	FM 31–70 FM 31–71
ST 13–16	Practical work	Night patrolling: 1. Land navigation. 2. Infiltration through enemy security lines. 3. Ambush.	FM 31–70, FM 31–71. Another squad, scheduled to train in security of an outpost, will be used as aggressor force.
ST 17–20	Practical work	Squad as outpost on open flank or in the gap between neighboring unit (night training): 1. Shuttle patrolling. 2. Activity of listening post. 3. Preventing infiltration.	FM 7–15, FM 31–70. Another squad, scheduled to train in night patrolling, will be used as aggressor force.
ST 21–24	Practical work	Squad in delaying action: 1. Ski tracks made in advance 2. Deceptive methods 3. Arranging ambushes 4. Mining of ski or snowshoe tracks	FM 7–15 FM 31–70 FM 31–71
ST 25–28	Practical work	Squad in attack	FM 7–15, FM 31–70, FM 31–71. Short review of squad combat formations.

SMALL UNIT TRAINING—Continued
Subject Schedule

CODE ST
Total periods 56

Periods	Type of instruction	Subject	References and remarks
ST 29–32	Practical work	Squad in defense	FM 7–15, FM 31–70, FM 31–71.
ST 33–36	Practical work	Platoon as advance guard and trailbreaking party: 1. Trailbreaking 2. Occupying critical terrain 3. Flank security	FM 7–15, FM 31–71
ST 37–40	Practical work	Platoon as outpost on open flank (night training): 1. Perimeter defense 2. Security tracks and shuttle patrolling 3. Bivouac 4. Use of trip flares	FM 7–15, FM 31–71, Another platoon, scheduled to train in "infiltration," will be used as aggressor force.
ST 41–44	Practical work	Platoon infiltrating through enemy security lines and assembling at a given point behind enemy lines (night training).	FM 31–70, Another platoon, scheduled to train in "Platoon as an outpost," will be used as aggressor force.
ST 45–48	Practical work	Platoon in attack in woods. An independent mission, such as capturing an enemy stronghold located on the flank or forward of the enemy FEBA.	FM 7–15, FM 31–71, Another platoon scheduled to train in "Platoon in Defense," can be used as agressor force.
ST 49–52	Practical work	Platoon in defense. An independent mission, such as defending a road block.	FM 7–15, FM 31–71, Another platoon, scheduled to train in "Platoon in Attack," can be used as aggressor force.
ST 53–56	Practical work	Platoon in delaying action. An independent mission, such as a combat outpost withdrawing to the FEBA.	FM 7–15, FM 31–71. Attention should be paid to aggressiveness and thorough preparedness to execute the delaying action.

SKIING
Subject Schedule

CODE SK
Total periods 72

Periods	Hours	Type of instruction	Subject	References and remarks
SK 1	1½	Conference and practical work.	Nomenclature, use, and care of ski equipment; adjustment of bindings; use of ski waxes and climbers.	FM 31-70, Individual equipment blow torch, pinetar, waxes, tools. Blackboard, projector, and screen. TF 7-2395; "Basic Military Skiing Part 1 — Selection and Care of Equipment."
SK 2	¾	Conference	Skiing techniques	Projector and Screen TF 7-2396 "Basic Military Skiing Part II — Skiing Techniques."
SK 3	2	Conference and practical work.	Adjustment of bindings and waxing of skis .	Ski equipment and screw drivers.
SK 4	¾	Conference and practical work.	Ski drill	FM 31-70, Ski equipment.
SK 5	2½	Conference and practical work.	Walking on skis with and without poles and with step turns.	FM 31-70, Ski equipment.
SK 6	1	Conference and practical work.	The lunge	FM 31-70, Ski equipment.
SK 7	4	Conference and practical work.	One step	FM 31-70, Ski equipment.
SK 8	4	Conference and practical work.	Two step	FM 31-70, Ski equipment.
SK 9-12	1	Practical work	Ski drill to include straight uphill climbing, side step, uphill traverse.	FM 31-70, Ski equipment.

SKIING—Continued
Subject Schedule

CODE SK
Total periods 72

Periods	Hours	Type of instruction	Subject	References and remarks
SK 13–17	6½	Practical work	Ski drill to include side step traverse, herringbone, straight downhill running (concurrent with climbing steps).	FM 31–70, Ski equipment.
SK 18	6	Practical work	Snowplow	FM 31–70, Ski equipment.
SK 19	2	Practical work	Half snowplow	FM 31–70, Ski equipment.
SK 20	2	Practical work	Pole riding	FM 31–70, Ski equipment.
SK 21	4	Practical work	Side slipping	FM 31–70, Ski equipment.
SK 22	8	Practical work	Snowplow turn	FM 31–70, Ski equipment.
SK 23	4	Practical work	Bump riding	FM 31–70, Ski equipment.
SK 24	16	Practical work	Cross-country ski marches (adapting techniques to terrain).	All previous references. Ski equipment.
SK 25	6	Practical work	Variations of cross-country ski steps	FM 31–70, Ski equipment.

UNIT TRAINING AND TACTICS
Subject Schedule

CODE UT
Total periods 72

Periods	Type of instruction	Subject	References and remarks
UT 1	Conference	Peculiarities in defense in winter conditions	FM 31–71.
UT 2–5	Practical work	Reinforced company in defense: 1. Selection of position 2. Grouping 3. Building and strengthening snow positions 4. Camouflage and concealment 5. One platoon in reserve 6. Fighting	FM 7–11, FM 31–70. 1. Positions must be low and well camouflaged. 2. Reserve platoon prepares counterattack, trails, and rear positions. 3. Tents are dug into snow just behind the positions.
UT 6–16	Conference and practical work.	Company in bivouac: Security in bivouac of a separate company. 1. Moving to the bivouac area 2. Complete bivouac arrangements 3. Security: Perimeter defense 4. Aggressor activity	FM 31–70, FM 31–71. Company moves to the bivouac area and arranges perimeter security during the day. Security problems continue as night exercise.
UT 17–20	Practical work	Company in delaying action: 1. Preparing trails 2. Moving of crew-served weapons on sleds 3. Use of smoke 4. Maximum use of mines, traps, and abatis	FM 7–11, FM 31–70, FM 31–71. In deep snow the enemy follows tracks. Therefore, our trails should be so made that the enemy is drawn diagonally into our fields of fire.
UT 21	Conference	Peculiarities in attack in winter conditions	FM 31–71.
UT 22–29	Practical work	Envelopments with the company on the open flank of the battalion: 1. The envelopment should be used. 2. Trailbreaking party screen from assembly area to attack positions.	FM 7–11, FM 31–71. In winter operations, the best objectives are often enemy lines of communication.

Periods	Type of instruction	Subject	References and remarks
		3. Objectives to cut the lines of communication of the enemy reorganization, defense, and roadblocks. Rest of battalion attacks rear of enemy.	
UT 30–33	Practical work	Reserve company in the attack: 1. To secure the open flank. 2. Preparations to strengthen the attack. 3. Reserve to be equipped with tracked vehicles for moving the company and, by skijoring rapidly, for parallel pursuit or envelopment. 4. Pursuit and cutting enemy communications.	FM 7–11, FM 31–71. Reserve company must be lightly equipped and have high mobility. M–113 to be used extensively.
UT 34–37	Practical work	The company as advance guard: 1. Trailbreaking. 2. Flank security by dispatching detachment to critical points. 3. Close flank movements of the advance party and the support proper.	FM 7–11, FM 31–71. 1. Breaking the enemy resistance is characterized by close and rapid flanking movements. 2. When the advance party makes close flanking movements, the support proper may send a new platoon to follow the retreating enemy. 3. If the terrain is unsuitable for envelopment of the advance party, the support proper, or part of it, makes the envelopment.

UNIT TRAINING AND TACTICS—Continued
Subject Schedule

CODE UT
Total periods 72

Periods	Type of instruction	Subject	References and remarks
UT 38	Conference and demonstration.	General principles of using tanks. Infantry and tank team in the attack.	FM 7–11, FM 17–15.
UT 39–42	Practical work	Infantry and tank team in attack	FM 7–11, FM 17–15.
UT 43–49	Practical work	Company as a raiding party: 1. M–113 raid to the flank where the enemy security trail will be passed. 2. Escorting detachments to be formed to secure the crossing of the enemy security trail for the raiding party. 3. Raid in enemy rear area 4. Evacuation of casualties 5. Rear guard, ambushes, mines, traps in withdrawal from action. 6. Returning raiding party must not use old trails	FM 7–11, FM 31–70, FM 31–71. To provide high mobility: 1. Light equipment. 2. The number of heavy crew served weapons to be reduced to a minimum. 3. Minimum number of sleds for evacuation purposes.
UT 50	Conference	Company as a screening force on the open flank in defense.	FM 7–11, FM 31–71
UT 51–57	Practical work	Reinforced company on the open flank as a screening and security force: 1. Outposts are placed on natural routes leading from enemy lines. 2. Perimeter defense of outposts, road blocks. 3. A system of contact patrols set up between outposts. 4. Strong and mobile reserve; trails from the location of reserves are opened to outposts.	FM 31–71. Special attention paid to communications.

Periods	Type of instruction	Subject	References and remarks
		5. Concentration of the reserve and nearby outposts against the infiltrating enemy. 6. Reconnaissance.	
UT 58–72	Practical work	2 day company problem: 1. 16 to 20 km fast movement of the reinforced company with the aid of tracked vehicles to capture a key terrain feature. 2. Hasty defense 3. Overnight bivouac 4. Delaying action	FM 31–70, FM 31–71. During the march the men riding in tracked vehicles and sleds must be rotated with men skijoring.

FIELD FORTIFICATIONS
Subject Schedule

CODE FD
Total periods 8

Periods	Type of instruction	Subject	References and remarks
FD 1–4	Demonstration and practical work.	Preparing defensive positions: 1. Foxholes 2. Crew-served weapons 3. Use of explosives to facilitate digging	FM 31–70 and TM 5–349. Attention should be centered on ways to camouflage the position during work, and ways of preparing improvised support for weapons. TF 5–2372, "Field Engineering in Subarctic, Part II — Winter Field Fortifications" (22 min.).
FD 5–8	Demonstration and practical work.	Obstacles in winter conditions: 1. Road blocks 2. Concertina wire 3. Mines	FM 31–70, FM 31–71. TF 5–2373, "Field Engineering in the Subarctic, Ice Mines, AT and AP Mines, and Obstacles" (18 min.).

BATTALION PROBLEMS
Subject Schedule

CODE BP
Total periods 31

Periods	Type of instruction	Subject	References and remarks
BP 1–16	Practical work	Battalion in the attack (on an exposed flank): 1. Movements from assembly area to the LD under cover of darkness. 2. Measures taken to protect the open flank. 3. Displacing the supporting weapons during the attack. 4. Reorganization and bringing the sleds and skis forward when the objective has been taken after final assault.	FM 7–20, FM 31–71.
BP 17–31	Practical work	Battalion in perimeter defense (both flanks open): 1. Organizing defense on high ground. 2. Flank security by shuttle patrols or outposts. 3. Digging and camouflaging of positions. 4. Location of reserve and its preparedness. 5. Aggressive, strong combat patrols used for harassing the enemy when preparing for attack.	FM 7–20, FM 31–71.

TESTS AND COMPETITION
Subject Schedule

CODE TC
Total periods 20

Periods	Type of instruction	Subject	References and remarks
TC 1–4	Practical work	Cross-country race	FM 31–70
TC 5–8	Practical work	Two phase cross-country race, or combination of two phase race and firing.	In these races, platoon representatives are selected for company ski meet.
TC 9–12	Practical work	Ski patrolling	
TC 13–20	Practical work	Ski competition for brigade championship 1. Cross-country race. 2. Two phase cross-country race. 3. Ski patrolling.	FM 31–70 Competition should be company and battalion race for championship.

CARE AND CLEANING OF EQUIPMENT
Subject Schedule

CODE CE
Total periods 8

Periods	Type of instruction	Subject	References and remarks
CE 1–8	Practical work	Care: 1. Skis and poles 2. Snowshoes 3. Tents and stoves 4. Other winter equipment 5. Clothing	1 hour period weekly.

COMMANDER'S TIME
Subject Schedule

CODE CT
Total periods 36

Periods	Type of instruction	Subject	References and remarks
CT 1–36	.....	Reserve for unit commanders, must include mandatory subjects such as character guidance, etc.	4 hour period weekly.

INCLOSURE 1
Part I

SPECIALIST TRAINING
VEHICLE OPERATORS COLD WEATHER TRAINING
(WHEEL AND TRACK LAYING VEHICLES)
Subject Schedule

CODE VO
Total periods 20

Periods	Type of instruction	Subject	References and remarks	Training aids
VO–1	Conference and demonstration.	Introduction and orientation to winter operation of wheel and tracked vehicles.	FM 31–70, FM31–71, TM 9–207, TM 9–273 Lubrication.	Training films as required. Appropriate vehicles.
VO–2–3	Conference and demonstration.	Before, during, and after operation maintenance services necessary for completeness.	FM 31–70, FM 31–71, TM 9–207, TM 9–273 and pertinent vehicle TM's.	Training films as required.
VO–4–5	Conference, demonstration, and practical work.	Power plant heaters. Operation, use, and maintenance.	TM 9–8662, TM 9–207.	Heater assemblies and winterized vehicles.
VO–6–7	Conference, demonstration, and practical work.	Personnel heaters. Operation, use, and maintenance.	TM 9–8662, TM 9–207.	Heater assys & winterized vehicles.
VO–8–9	Conference, demonstration, and practical work.	Cold Starting Aid Kit M40 (Slave Kit) principles of operation, servicing, maintenance, and necessary precautions.	TB ORD 390 Operation and maintenance of Cold Starting Aid Kit M40 (Slave Kit). TM 9–207.	Slave Kit M40.

INCLOSURE 1
Part I—Continued

SPECIALIST TRAINING
VEHICLE OPERATORS COLD WEATHER TRAINING
(WHEEL AND TRACK LAYING VEHICLES)
Subject Schedule

CODE VO
Total periods 20

Periods	Type of instruction	Subject	References and remarks	Training aids
VO–10	Conference and demonstration.	Lubrication—Importance of the correct lubricant, correct amount, and application procedures.	TM 9–273 Lubrication, pertinent lubrication orders, SM 3–C68P–ML, Vol 2, List of standard lubricants, hydraulic fluids, liquid fuels, and preservative materials. TM 9–207.	Samples of cold weather lubricants and related items. FB 9–221.
VO–11	Conference and demonstration.	Batteries and Tires—Effects of extreme cold. Cold weather servicing and maintenance.	TM 9–1870–1 Care and maintenance of pneumatic tires. TM 9–6140–200–15 Operation Organizational Field and Depot maintenance of storage batteries lead-acid type.	Charts contained in referenced technical manuals.
VO–12–13	Conference, demonstration, and practical work.	Cold weather engine starting and warmup period. Problems encountered and corrective action. Harmful effects of engine idling.	TM 9–207. TM 9–273 Lubrication pertinent Vehicle Technical Manuals.	Charts contained in TM 9–273.
VO–14	Conference and demonstration.	Suspensions and Power Trains—The effects of extreme cold on brakes, axles, gear boxes, and steering mechanisms.	TM 9–207. TM 9–273 Lubrication, pertinent Vehicle TM's.	

INCLOSURE 1
Part I—Continued

SPECIALIST TRAINING
VEHICLE OPERATORS COLD WEATHER TRAINING
(WHEEL AND TRACK LAYING VEHICLES)
Subject Schedule

CODE VO
Total periods 20

Periods	Type of instruction	Subject	References and remarks	Training aids
VO–15–16	Conference, demonstration, and practical work.	Winter driving problem encountered and corrective measures.	TM 21–300, TM 21–301. TM 21–305, manual for wheel vehicle driver. TM 21–306, manual for full-track vehicle driver.	Training films as required.
VO–17	Conference.	Cross-country operations.	TM 21–300, FM 31–70, TM 21–301, FM 31–71, TM 21–305, TM 9–207, TM 21–306. Pertinent vehicle TM's.	Training films as required.
VO–18	Conference and demonstration.	Problems peculiar to wheel vehicles in cold weather operation and corrective measures.	Pertinent vehicle TM's. FM 31–70, FM 31–71, TM 9–207.	
VO–19–20	Conference and demonstration.	Problems peculiar to tracked vehicles in cold weather operation and corrective measures.	Pertinent vehicle TM's. TM 9–207, FM 31–70, FM 31–71.	

PART II — COLD WEATHER ORGANIZATIONAL MAINTENANCE OF VEHICLES (WHEEL AND TRACK LAYING VEHICLES) — CODE VM

Subject Schedule — Total periods 20

Periods	Type of instruction	Subject	References and remarks	Training aids
VM-1-2	Conference, demonstration, and practical work.	Maintenance in extreme cold. Problems encountered and procedures to be utilized.	TM 9-207, FM 31-70, FM 31-71.	Training films as required.
VM-3	Conference and demonstration.	Lubrication—cold weather lubricants, application and use.	TM 9-273—Lubrication. TM 9-207. SM 3-C68P-ML, Vol 2, List of Standard Lubricants, Hydraulic Fluids, Liquid Fuels, and Preservative materiel used by the Army.	
VM-4-5	Conference, demonstration, and practical work.	Power plant heaters. Trouble-shooting and maintenance.	TM 9-273, TM 9-207, TM 9-8662.	Heater assys and components.
VM-6-7	Conference, demonstration, and practical work.	Personnel heaters trouble-shooting and maintenance.	TM 9-8662, TM 9-207.	Heater assys, appropriate vehicles.
VM-8-9	Conference, demonstration, and practical work.	Cold Starting Aid Kit M40 (Slave Kit) use, trouble-shooting, and maintenance.	TM 9-207. TB ORD 390 Operation and maintenance of Slave Kit M40.	Slave Kit M40, appropriate vehicles.
VM-10	Conference and demonstration.	Batteries — effects of extreme cold, proper charging, and maintenance procedures.	TM 9-6140-200-15, storage batteries lead-acid type — operation and maintenance.	6TN and 2HN batteries.
VM-11	Conference, demonstration, and practical work.	Low voltage circuit tester—operation, use, and proper maintenance.	TM 9-207, FM 31-70, FM 31-71.	Low voltage circuit tester.

PART II—Continued

COLD WEATHER ORGANIZATIONAL MAINTENANCE OF VEHICLES (WHEEL AND TRACK LAYING VEHICLES)

Subject Schedule

CODE VM
Total periods 20

Periods	Type of instruction	Subject	References and remarks	Training aids
VM–12–13	Conference, demonstration, and practical work.	Effects of cold weather starting and warmup of internal combustion engines. Proper starting and warmup procedures.	TM 9–207, TM 9–273.	Charts and graphs in TM 9–207.
VM–14	Conference and demonstration.	Suspensions and power trains. Preventive measures and maintenance.	TM 9–207, TM 9–273.	
VM–15–16	Conference, demonstration, and practical work.	Hydramatic transmissions cold weather problems. Correct procedures developed and lubricants used.	TM 9–207. TM 9–1819, AC–power trains TM 9–8024, organizational maintenance of 2½ ton cargo trucks.	GMC–M211, power pack transmission.
VM–17–18	Conference, demonstration, and practical work.	Items peculiar to wheeled vehicles during cold weather operation; malfunctions, failures, and preventive actions.	Vehicle TM's, TM 9–207	
VM–19–20	Conference, demonstration, and practical work.	Items peculiar to tracked vehicles during cold weather operation. Specific malfunctions, failures, and preventive procedures.	Vehicle TM's, TM 9–207.	

PART III

WEAPONS
(SMALL ARMS)
Subject Schedule

CODE SW
Total periods 4

Periods	Type of instruction	Subject	References and remarks	Training aids
SW–1	Conference and demonstration.	Effects of extreme cold weather firing.	Pertinent weapons FM's; FM 31–70, FM 31–71, TM 9–207.	Actual specimens
SW–2–3	Conference, demonstration, and practical work.	Maintenance of small arms weapons. Care, cleaning, and lubricating procedures.	Weapons FM's; TM 9–1–1025, 30,55,90,95; TM 9–273, lubrication.	Actual specimens
SW–4	Conference and demonstration.	Problems peculiar to small arms and corrective action—storage in extreme cold.	TM 9–207; TM 9–273.	

Part IV

WEAPONS
(ARTILLERY)
Subject Schedule

CODE AW
Total periods 6

Periods	Type of instruction	Subject	References and remarks	Training aids
AW–1–2	Conference and demonstration.	Effects of extreme cold on recoil mechanisms — Warmup procedures.	Pertinent artillery FM's and TM's; TM 9–207; FM 31–70; FM 31–71.	
AW–3	Conference, demonstration, and practical work.	Lubrication—types of lubricants and uses.	TM 9–273, TM 9–1–1025,30,55, 90,95.	
AW–4–5	Conference, demonstration, and practical work.	Maintenance of artillery weapons—care, cleaning, and lubricating procedures.	Pertinent weapons FM's, TM's; TM 9–273; TM 9–207.	
AW–6	Conference and demonstration.	Problems peculiar to artillery weapons and corrective measures.	FM 31–70, FM 31–71, TM 9–207, pertinent weapons TM's.	

Part V

FIRE CONTROL
(OPTICAL)
Subject Schedule

CODE FC
Total periods 2

Periods	Type of instruction	Subject	References and remarks	Training aids
FC–1	Conference and demonstration.	Effects of extreme cold on optical equipment—proper handling and storage procedures.	TM 9–207.	
FC–2	Conference, demonstration, and practical work.	Organizational maintenance and problems peculiar to optical instruments.	Pertinent instrument TM's; TM 9–207.	

INCLOSURE 2

INLAND WATERWAYS NAVIGATION
(OPERATORS TRAINING)

CODE IWN
Total periods 74

Periods	Type of instruction	Subject	References and remarks
IWN 1	Conference.	Significance of Inland Waterways 1. Inland Waterways in Northern Areas 2. Use of Waterways in Underdeveloped Areas 3. Influence of Inland Waterways on Tactical Operations	FM 31–71
IWN 2–4	Conference, training film, and demonstration.	River Navigation and Basic Boat Operation 1. Fundamentals of River Reading 2. River Navigation 3. Characteristics and Nomenclature of the Boat 4. Characteristics and Nomenclature of the Outboard Motor 5. First Echelon Maintenance of Boat, Motor, and Related Equipment 6. Rules of Water Safety	TM 5–210; TF 55–2296; FM 21–11; Operation Instructions Manual for Outboard Motor.
IWN 5	Conference.	River Charting 1. Techniques of River Charting 2. Chart Sketching and Sketching Equipment	FM 21–31
IWN 6–74	Practical work.	River Navigation 1. River Charting 2. River Patrols 3. Tactical River Navigation Exercise 4. Boat Operation 5. Boat and Equipment Maintenance	All previous

APPENDIX III

COMMANDERS' GUIDE LINES FOR NORTHERN OPERATIONS

1. Leadership

a. Commanders at all echelons must know, understand, and appreciate the problems of northern operations.

b. Actively supervise, keep abreast of the important details in tactical operations, and coordinate closely with adjacent and supporting commanders.

c. Forceful action is the key to success of the leader in the north.

d. Be sure your command is safety conscious. Check for fire hazards—especially gasoline handling, carbon monoxide poisoning, frostbite, and safe driving habits.

2. Tactics

a. Mobility must be considered one of the cardinal principles of operations in the north. True mobility can only be obtained through proper use of all aviation support, oversnow equipment, and tracked vehicles.

b. Rapid movement of small units with adequate firepower, mobility, and communications plays the vital role in the success of northern operations. Operational planning must include the use of vertical envelopment and wide flanking attacks to exploit the principle of surprise.

c. Because of vulnerability of forces in daylight, brought on by slow movement and problems of concealment, night operations should be a prime consideration.

d. Troops in northern operations are particularly dependent upon their lines of communications, whether by air, road, or trail, since supplies and equipment are required to maintain operational effectiveness. An enemy can be defeated by interdiction of the lines of communication or its destruction by air operations or by the interposition of forces between his base of supply and his forward elements.

e. The construction of an adequate ground LOC to forward elements is prohibitive in terms of engineer effort required. Therefore, emphasis must be placed on the following: air supply and resupply; use of low ground pressure vehicles; and, in some instances, by foot.

f. Combat effectiveness is most difficult to maintain unless troops are kept warm, fully hydrated, and in condition to fight. Thus, a force long exposed to the elements and not accompanied by warming equipment and other essential support is in an ideal position to be vulnerable to counterattack.

3. Communications

a. The communications net is the commander's nerve center. Communications provide control; control permits command. Unceasing effort is required to maintain the flow of traffic.

b. Communications is a system or series of systems which include tank, infantry, artillery, and air communications nets. All alternate means must be employed to provide continuous communications to all elements of the task force.

c. Use aircraft for radio relay and message delivery.

d. Battery vests or other suitable means must be used to keep batteries warm.

e. Plan a forward maintenance capability.

f. Minimum variation in radio location has considerable effect on transmission ranges; try another transmitter site if unable to transmit or receive.

g. Because of reliance on radios, be especially aware of communications security. Use appropriate codes and keep traffic to a minimum.

4. Artillery and Fire Support

a. Close and continuous personal contact between the Battle Group Commander and the Artillery Commander is essential to permit displacement with minimum instructions and to insure continuous fire support.

b. Forward observers must be properly equipped and wholly responsive to the Infantry Company Commander's needs. He must remain in close and continuous personal contact. Infantry and Artillery information must flow via both infantry and artillery means.

c. Artillery FOs and forward air controllers should use Army aircraft to coordinate and direct fire support where feasible.

d. Helicopters should be used whenever possible for rapid displacement of artillery.

5. Aviation

a. Task force air officers should be used to maintain the status of all assigned aircraft and to direct maximum employment which will insure constant productive utilization of aircraft during those hours in which aircraft can be flown.

b. Payload capability of aircraft is reduced in the Arctic because of added weight of ski installations and required survival equipment.

c. Rotor systems and engine exhaust often cause ice fog which may create delays in launching of aircraft. For this reason, use pre-packaged helicopter loads to save ground time.

d. Use lakes for airfields to save construction time.

e. Plotting accurate ground positions is difficult in terrain with few recognizable landmarks. Use pilots to assist in determining unit positions, as they can see the units in their relationship to each other landmarks.

f. Arrange for commanders to reconnoiter terrain from the air. Use aircraft to guide moving columns.

g. Pilots should habitually monitor command nets and offer to relay communications.

h. Aircraft should be employed on station as an aerial relay for communications where required.

i. Aircraft loads must be carefully planned and loaded during periods of non-flying weather to permit immediate dispatch at first break in weather or light.

6. Engineers

a. Make maximum use of Engineer support available. Engineers are vital because of: water supply, road and bridge construction, ADM teams, construction and neutralization of barriers, obstacles, fortification, construction of airfields, and camouflage.

b. If an Engineer staff officer is not available, use attached engineer commanders to coordinate staff planning and the overall engineer effort.

7. Intelligence and Security

a. Make maximum use of all intelligence collecting agencies, with emphasis on use of Army aviation.

b. Cross-country navigation is extremely difficult. Use Army aviation to assist in maintaining direction. Do not rely solely on maps and the compass.

c. Route reconnaissance must precede any troop movement. Terrain obstacles often make the "long way around" the best route.

d. Be especially aware of sound and light discipline in forward areas.

e. Emphasize deception. (Effective camouflage and concealment are extremely difficult.)

f. The isolation and destruction of widely separated guerrilla forces requires forceful action on the part of commanders. The adoption of conventional tactics with emphasis on the seizure of terrain will not substitute for the isolation, fragmentation, and capture of guerrilla bands.

8. Logistics

a. Preventive maintenance requires much additional time and effort and must be a matter of major concern and emphasis by all members of the chain of command.

b. Winter driving and operation of equipment must be stressed.

c. Plan logistical support in great detail even for small unit operations.

d. Insure that the command is provided adequate support to include sufficient heat, food, clothing, sleeping gear, tentage, POL, and ammunition resupply.

e. During extreme temperatures, plan additional time for accomplishment of tasks, as experience has shown that two or three times the norm may be required.

f. Frostbite causes casualties; do not underestimate effects of cold.

GLOSSARY

Accumulation — Net gain of snow or ice during a specific period of time. The opposite of ablation.

Ahkio — Boat-like sled used for pulling squad equipment. (Also "pulka")

Breakup — Period of spring thaw during which the ground surface is excessively wet and soft, and ice is disappearing from streams and lakes. Duration of the breakup period varies usually from one to six weeks depending on regional and local climatic conditions. The breakup season causes difficult movement problems.

Chilblains — A cold injury which causes lesions — usually on the hands — caused by prolonged or repeated exposure to mild humid cold.

Chinook — Warm dry wind which raises the temperature and melts snow from the ground.

Cold Injury — An inclusive term applied to injuries resulting from cold. The most common are frostbite, trenchfoot, immersion foot, and chilblains.

Cornice — An overhanging formation of snow, usually on a ridge or at the top of a gully on a mountainside.

Crack — A fissure or crevice in a rock or ice formation.

Cyclonic Storms — A storm system of winds, often violent, with abundant precipitation and a usual diameter of 80 to 1440 km. It is characterized by winds rotating a calm center of low atmospheric pressures, often at speeds as high as 144 to 210 km. per hour. These storms are called hurricanes in the West Indies. The winds rotate clockwise in the Southern Hemisphere and counterclockwise in the Northern Hemisphere.

Dry Snow Zone — Zone of ice cap where maximum temperatures are not high enough to cause melting.

Fast Ice — All types of ice, broken or unbroken, attached to the shore, beached, stranded, or attached to the bottom in shoal water.

Freezeup — Period during which the ground surface freezes and

ice cover forms on streams and lakes. This period varies from one to three months depending on regional and local climatic conditions. Maintaining mobility during this period becomes easier as the period progresses.

Frostbite — A cold injury caused by freezing of the tissues.

Frost Boil — Accumulation of excess water and mud in subsurface materials during spring thawing. It usually weakens the surface and may break through, causing a quagmire.

Frost Line — (See frost table.)

Frost Mound — A localized uplift of land surface caused by frost heaving or by ground water pressure. Also called earth mount, earth hummock, pals, pingo, or pingok.

Frost Table — More or less irregular surface that represents the depth of penetration of the winter frost in the seasonal frozen ground. It may or may not coincide with the permafrost table.

Fuel Tablets — Concentrated chemical fuel dispensed in tablet form for heating rations.

Ice Fog — A fog of suspended ice crystals usually formed with the introduction of water vapor into clear, calm air of low temperatures (—20° F. or lower). Ice fog is rare at temperatures above —20° F. and almost always present at temperatures below—50° F. Ice fog may form over a body of troops, herd of animals, bivouac areas, motor parks, airfields, convoys, and gun positions during firing.

Immersion Foot — An injury resembling trenchfoot caused by prolonged immersion of the extremities in warm water (up to 70° F.).

Layer Principle — Attaining additional insulation by trapping dead air in the space(s) between successive layers of clothing. Two or more thicknesses of clothing, with intervening air space, provide greater insulation than the same thickness of clothing of the same material in a single layer.

Muskeg — Poorly-drained organic terrain which is characteristic of the Subarctic, covered with a thick, resilient carpet of water-sodden mosses and tussocks, and underlain by a high water table, peat of variable thickness, and often permafrost.

Poling — A pushing movement of arms and body with the ski poles against the snow to increase momentum in the slide. Single poling is referred to when each pole is used alternatively to obtain this propulsion. Double poling is the use of both poles at the same time.

Santruga — Zastruga (Russian) — One of a series of long parallel

snow ridges, occurring on the open plains and formed by the action of winds.

Snow Bridge — The snow mass that sometimes covers the surface opening of a crevasse.

Tractor Sled Train (for oversnow movement) — A train usually composed of cargo sleds and wanigans and towed by track laying or other type oversnow vehicles.

Treeline — The upper limit of erect trees in mountainous regions or the northern limit of erect trees in the Arctic.

Trenchfoot — A cold injury caused by prolonged exposure to a cold environment (near freezing) that is damp or wet.

Tundra — A flat or gently rolling area with a muck to rock surface over permafrost and consisting of a low mat of grasses, shrubs, and other plants. This area is found above or north of the treeline.

INDEX

	Paragraph	Page
Administration:		
Layout of sites	62	59
Organization	58–61	55
Planning	53	48
Aerial:		
Combat reconnaissance	22	23
Delivery	48	43
Navigation	48, 109, 110	43, 90
Photography	169	138
Tactical air support	49	47
Airborne	48	43
Air defense artillery	104	84
Air Force:		
Tactical air support	49	47
Troop carrier	48	43
Air transportation	48	43
Ammunition:		
Environmental effects	83, 92, 101	70, 76, 83
Flame	117	97
Levels	63	60
Mines. *(See* Mines and minefields.)		
Smoke	118	98
Storage	64	61
Tank ammunition handling	93	77
Amphibious:		
Operations	45	39
Shore party	45	39
Supply by water	47	41
Supporting arms	46	41
Armor:		
Effects of deep snow	86	72
Effects of transitional period	88, 89	73, 74
Maintenance	95	78
Operations	94	77
Role	85	72
Tank ammunition	93	77
Army aviation:		
Aerial navigation	109, 110	90
Combat reconnaissance	22	23
Effects of weather	107	88
Landing sites	106, 127	86, 109

	Paragraph	Page
Army aviation—Continued		
Maintenance	111	90
Mission	105	86
Suport:		
Artillery	97, 99	80, 82
Command and control	15	15
Logistical operations	55	51
Long range patrols	22	23
Medical evacuation	68	64
Signal communication activities	149, 160, 166	128, 135, 137
Traffic control	70	65
Artillery:		
Air defense	104	84
Fire direction	101	83
Mobility	97	80
Observation	99	82
Position areas	98	81
Role of	96	79
Survey and metro	100	82
Camouflage and concealment:		
Artillery position areas	98	81
Bivouac sites	23	24
Infantry	79	69
Summer	23	24
Techniques	128	111
Training	186	143
Winter	23	24
CBR warfare:		
Biological	115	94
Chemical	114	92
Flame	117	97
Radiological	116	95
Smoke	118	98
Climate. (*See* Environmental effects.)		
Clothing	140	122
Combat Intelligence. (*See* Intelligence.)		
Communications. (*See* Signal communications.)		
Concept of operations:	10	10
Considerations	13	13
Fire support	12	12
Special factors	11	11
Task forces	84	71
Conduct of operations:		
Defensive. (*See* Defensive operations.)		
Offensive. (*See* Offensive operations.)		
Retrograde. (*See* Retrograde movements.)		
Special. (*See* Special operations.)		
Time lag	20	21
Cooking	186	143
Counterintelligence. (*See* Intelligence.)		

	Paragraph	Page
Daylight and darkness	8, 11	7, 11
Deceptive measures	6, 23, 79, 128	5, 24, 69, 111
Defensive operations:		
Composition and location of reserve	37	32
Field fortifications	34	30
General considerations	34	30
Positions	35	31
Security	36	31
Electronic warfare	155	132
Engineers:		
ADM	130	113
Airfields	127	109
Camouflage	128	111
Field fortifications	124	101
Mines and minefields	129	112
Mission	123	100
Problems	131	113
Roads and trails	125	103
Water supply	132	115
Environmental effects	8, 9	7
Airborne operations	48	43
Amphibious operations	45	39
Armor	86–89	72
Army aviation	107	88
Artillery	101	83
Basic considerations	3	5
Mobility	17	16
Nuclear weapons	119–121	99
Operating conditions	9	7
Signal communications	148, 150–154, 158, 162	127, 128, 133, 136
Special factors	11	11
Equipment:		
Aviation	16, 106	16, 86
CBR	114, 116	92, 95
Engineer:		
Construction	124	101
Snow and ice melting	132	115
Inland waterway	43	36
Ordnance	137	120
Quartermaster	139, 140	121, 122
Repair	187	144
Requirements	54	49
Signal	141	124
Evacuation:		
Medical	68, 133	64, 118
Ordnance	136	120
Prisoners of war	76	67
Remains	139	121

Field artillery. *(See* Artillery.)

	Paragraph	Page
Field fortifications:	34, 124	30, 101
Snow wall material	124	101
Training	186	143
First aid and hygiene:		
Training	186	143
Flame and smoke	117, 118	97, 98
Foot mobility	17	16
Freezeup	89	74
Glaciers	18, 44, 96, 106	19, 38, 79, 86
Glossary		
Ice:		
Cover	11	11
Crossing	87	73
Fog	11	11
Load bearing capacity	126	104
Mines	129	112
Operations on permanent ice areas	44	38
Reinforcement	126	104
Routes	126	104
Infantry:		
Effects of environment	80	70
Employment	84	71
Role	78	69
Training	app. II	152
Weapons. *(See* Weapons.)		
Inland waterways:		
Advantages and disadvantages	43	36
Navigation	43, 47	36, 41
Operations	43	36
Techniques	43	36
Type of craft	43	36
Use:		
Logistical support	56	55
Obstacles	124	101
Roads in winter	126	104
Water transportation	43	36
Intelligence:		
Collecting agencies	21	21
Counterintelligence	23	24
Deception	23	24
EEI	21	21
Patrolling	22	23
Leadership	3, 5	5
Logistics:	7, 10	6, 10
Ammunition and explosives	63	60
Direct support	60	58
Distribution	65	62
Food	63, 140	60, 122
General support	59, 61	56, 59
Maintenance. *(See* Maintenance.)		
Medical evacuation and hospitalization	67–69	64

	Paragraph	Page
Logistics—Continued		
Organization	58–62	55
Planning	53–57	48
POL	63, 140	60, 122
Storage	64	61
Theater support organization	59	56
Water supply	132	115
Maintenance:	66	63
Armor	95	78
Army aviation	111	90
Field	66	63
Ordnance	137	120
Organizational	66	63
Signal	156, 170–178	132, 138
Training	187	144
Medical:		
Evacuation	68, 133	64, 118
Hospitalization	69	65
Operations	133	118
Organization	134	119
Mines and minefields:		
Antipersonnel mines	34	30
Chemical	114	92
Employment	129	112
Ice mines	129	112
Mobility:	3, 6, 11	5, 11
Airborne	48	43
Armor	86–90	72
Artillery	97	80
Effect:		
Climate	17	16
Terrain	18	19
Foot	17	16
Ice routes. *(See* Ice.)		
Individual	83	70
Infantry	80, 83, 84, 88	70, 71, 73
Logistical	52, 55, 58	48, 51, 55
Roads	11, 125	11, 103
Time lag	20	21
Trailbreaking. *(See* Trailbreaking.)		
Vehicular	19	20
Mountain operations	42, 96	36, 79
Mud	8, 17, 88	7, 16, 73
Naval gunfire	46, 103	41, 84
Navigation:		
Aerial	48, 109, 110	43, 90, 90
Amphibious	47	41
Difficulty	11	11
Land	97	80
Maps	11	11

	Paragraph	Page
Navigation—Continued		
Training	186, 187	143, 144
Waterway	43, 47	36, 41
Night combat	6, 41	5, 34
Nonforested areas	18, 44	19, 38
Northern operations:		
Area of operations	2	3
Environmental effects. *(See* Environmental effects.)		
Organization	4, 14, 58	5, 13, 55
Planning	10	10
Special factors	11	11
Nuclear weapons:		
ADM	130	113
Effects of weather	119-121	99
Fire support planning	12	12
Protection	122	100
Observation of fire:		
Armor	92	76
Artillery	99	82
Infantry	81	70
Obstacles:		
Antitank	124	101
Ice	124	101
Mines. *(See* Mines and minefields.)		
Roadblocks	124	101
Water barriers	124	101
Wire	124	101
Offensive operations:	6	5
Attack of organized position	28	28
Conduct of attack	31	29
Control measures	26	28
Coordination	27	28
General considerations	24	25
Main attack	25	28
Movement to LD	30	29
Preparation for attack	29	29
Pursuit	32	30
Security in the offense	33	30
Operations. *(See* Northern operations.)		
Ordnance:		
Maintenance	137	120
Operations	136	120
Supply	138	121
Personnel:		
Discipline	75	67
Headquarters layout	77	68
Prisoners of war	76	67
Replacements	73	67
Selection	72	66
Prisoner of war:		
Evacuation	76	67

	Paragraph	Page
Psychological warfare	13	13
Pyrotechnics	164	137
Quartermaster:		
Service	139	121
Supply	140	122
Raids	40	33
Rain	17	16
Reconnaissance:		
Aerial combat	22	23
Ice routes	126	104
Long range	22	23
Route	19	20
References	app. I	149
Replacements	73	67
Retrograde movements	38, 39	32
Roads, railroads and trails:		
Ice routes	126	104
Roads and trails	125	103
Route selection	19	20
Seasonal effects. *(See* Environmental effects.)		
Security:		
Bivouac	23	24
Deception	6, 23	5, 24
Defensive operations	36	31
Offensive operations	33	30
Rear area	56	55
Signal communications:		
Antennas and grounds	153	130
Artillery	102	84
Atmospheric disturbances	150–152	128
Effects of environment	148, 150–154, 158, 162	127, 128, 133, 136
Electronic warfare	155	132
Maintenance	156, 170–178	132, 138
Messenger	165–167	137
Personnel	141	124
Photography	168, 169	138
Role	147	127
Techniques of wire construction	160	135
Visual	162–164	136
Skiing:	83	70
Training	186	143
Snowshoeing:	83	70
Training	186	143
Soil conditions	9, 17, 18	7, 16, 19
Special operations:		
Inland waterways	43	36
Low visibility	41, 57	34, 55
Mountain	42, 96	36, 79
Raids and rear areas	40	33

	Paragraph	Page
Tactical air	46, 49	41, 47
Tactical principles	6	5
Tanks:		
Crew comfort	94	77
Maintenance	95	78
Operations in extreme cold	94	77
Starting	94	77
Terrain:		
Barren lands	18, 44	19, 38
Effects:		
Armor	87–90	73
Artillery	96, 97	79, 80
Infantry	79	69
Traffic control	70	65
Trailbreaking:		
Crossing ice	126	104
Movement of detachment	20	21
Route selection for vehicles	19	20
Training:		
Areas	180	142
Camouflage	186	143
Clothing	186	143
Driver and maintenance	187	144
Emphasis	189	145
Field fortification	186	143
First-aid and hygiene	186	143
Food preparation	186	143
Hints for instructors	191–193	146
Indoctrination	186	143
Infantry	app. II	152
Instructor requirement	181, 190	142, 146
Map reading and navigation	186	143
Movement	186	143
Objectives	183	143
Officer and noncommissioned officer	188	145
Period	185, 190	143, 146
Program for winter instruction	app. II	152
Snowshoe and ski	186	143
Specialized	187	144
Subject schedules	app. II	152
Transportation	187	144
Weapons	186	143
Transportation:		
Air	146	126
Cross-country	55	51
Highway	145	125
Ports	143	125
Rail	144	125
Training	187	144
Water	47	41

	Paragraph	Page
Vehicles:		
Maintenance. *(See* Maintenance.)		
Mobility	19	20
Snow depths	17	16
Vessels:		
Inland waterways	43	36
Supply by water	47	41
Water:		
Distribution	132	115
Melting snow	132	115
Purification	132	115
Transportation	132	115
Water point	132	115
Weapons:		
Armor	92	76
Artillery	101	83
Infantry	81, 82	70
Mines. *(See* Mines and minefields.)		
Nuclear. *(See* Nuclear weapons.)		
Training	186	143
Whiteout	11, 41	11, 34
Winterization:		
Aircraft	111	90
Flame throwers	117	97
Protective mask	114	92
Vehicles	137	120
Withdrawals	39	32

BY ORDER OF THE SECRETARY OF THE ARMY:

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USACAS (10)
USAARMS (50)
USAIS (35)

NG: None.

USAR: None.

For explanation of abbreviations used, see AR 320-50.

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FM 31-71
CHANGE No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C. *24 August 1965*

NORTHERN OPERATIONS

FM 31-71, 10 January 1963, is changed as follows:

1. Purpose and Scope

(Superseded)

a. This manual provides doctrinal guidance to commanders and staffs for operation and administration of combat units in the northern regions of the world under conditions of limited war, general war, cold war, counterinsurgency operations in all levels of warfare, and nuclear and nonnuclear warfare. This manual indicates that cold, with its attendant unpleasantness and complicated living conditions, affects military operations but does not prevent them. The material contained in this manual is directed primarily toward operations below division level. Operations at division level and above will be essentially the same as those in other areas of the world. It is the forward elements of divisions or task forces that must overcome the many problems inherent in northern operations. Commanders and staff officers at all levels must understand and appreciate the effects of the northern environment on the operations of these forward units and carefully consider them when planning each operation. The reader should refer to FM 31-70 and FM 31-72 and to other manuals of the arms and services for further information concerning northern operations (app. I).

b. Users of this manual are encouraged to submit recommended changes or comments to improve this manual. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be forwarded direct to Commanding General, United States Army, Alaska, APO Seattle 98749.

4. Organization

(Superseded)

With modifications, the current Army divisions, and other combat, combat support, and combat service support units are suited for operations in the north. The changes in personnel structure and equipment authorizations are the result of added emphasis on the following: mobility, maintenance, communications, and additional logistical support. Certain items of equipment are eliminated or added based on their suitability to the terrain and environment.

5. Command Leadership

(Superseded)

Leadership is more demanding and important in the north than in most areas of the world. Emphasis is on small unit operations. Command is decentralized to insure maximum flexibility for leaders at all levels. Resourcefulness and initiative are requisites for unit commanders. *Forceful and personal leadership is the key to success in the north.* Commanders at all echelons must plan and prepare their operations in great detail, actively supervise, keep themselves and their subordinates informed, and maintain close coordination with adjacent and supporting units.

12. Fire Support

(Superseded)

Fire support planning for northern operations is basically no different than that required for more temperate regions. However, limited artillery mobility increases the *requirements for Army aviation aerial artillery and aerial fire support, and* tactical air support.

13. Additional Considerations

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c. (Superseded) The strategic location of certain remote northern areas and their characteristically severe climate, low population density, possible governmental neglect or disinterest resulting in antipathy, ignorance, or restlessness of the inhabitants, provides a target or breeding ground for subversive insurgency. Although generally not regarded as likely areas for insurgency, control of northern areas within the context of a larger plan, may as well be a cold war objective. If insurgency occurs, counterinsurgency operations must take place to maintain control of those areas for friendly forces exploitation of their strategic value (FM 31–16 and FM 31–22).

17. Effects of Climate

a. Winter Conditions.

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(3) (Superseded) Individual oversnow mobility is enhanced by the use of skis or snowshoes.

(*a*) Skis afford greater speed in moving, particularly over prepared trails and usually require less physical effort. Condition of snow (depth, trail broken, etc.) will affect this speed. Troops mounted on skis and towed by vehicles (skijoring) is an effective means for rapid cross-country movement where trafficability permits. Troops moving by this means will arrive at their destination less fatigued and in condition to conduct effective operations. Six to eight weeks are normally

required for troops to become adequate military skiers. However, this training time is only an approximation and depends largely on the adaptability of the troops. Some personnel will become proficient in two or three weeks while others, because of lack of coordination, etc., will never become proficient.

(*b*) Snowshoes, though slower than skis, require less training. Troops in good physical condition can develop adequate proficiency in a few hours. Snowshoe movement is more practical in confined areas, such as assembly areas, field trains, mortar and artillery positions. Snowshoes leave both hands free and generally provide more traction than skis when pulling ahkios or sleds. Ski poles, if available, will provide the snowshoer additional traction and support for sled pulling. Snowshoes can be carried more readily than skis and maximum effectiveness can be achieved without wax, as opposed to the desirability for ski treatment and a variety of waxes dependent upon temperatures and snow conditions.

(*c*) As a general rule, and as a goal, units that move on foot should be trained to become proficient on both skis and snowshoes. If training time is limited, personnel should be trained on snowshoes and only those personnel who are proficient skiers should be issued skis. These personnel can then be formed into provisional units for specialized missions requiring the speed and silent movement of skiers. Additionally, these provisional units can be used as a cadre to train other personnel.

21. Combat Intelligence

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h. (Superseded) After operations are initiated, some collection means, such as long range patrols, lend themselves to more than usual exploitation in obtaining information deep in enemy territory. Because of the unusually great operating distances, these patrols can often pass undetected through flank and frontal areas. Indigenous personnel assume increased importance as a source of information. Use of special forces working with the inhabitants in the area of operations prior to full scale operations will enhance the information-gathering capability of the ground forces.

22. Patrolling

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b. (Superseded) Reconnaissance and combat patrols may operate behind enemy lines for extended periods, depending upon climatic conditions and the capacity to provide support. Subject to equipment issued and weather conditions, such patrols can be self-sustaining for

periods of from 3 to 5 days without resupply except for ammunition that may become expended. Terrain and vegetation will generally favor such operations and survival from fish and game in most areas may extend the self-sustaining period. Ideally, personnel employed on these patrols should be specially trained, including mountain and glacier operation and in winter should be ski qualified. Snowshoes will, however, provide an adequate and reliable means of oversnow movement and their use allows greater latitude in the selection of personnel. Provision should be made for such patrols to carry, in addition to weapons, communication, etc., minimum equipment to construct improvised shelters. Prearranged supply drops in enemy territory may be used for replenishment of supplies.

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e. (Added) In long range patrolling communications are a prime consideration. Normally, radio is the principal means of communication; however, because of extended distances and difficulty in radio transmissions in northern areas, aerial relays or message pickup and drop techniques may have to be employed.

23. Counterintelligence

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b. Deception. (Superseded) Deception has an important role in northern warfare. False ski or snowshoe trails are made to mislead the enemy as to the size of the force, direction of movement, and scope of activity. Open camp fires can be started in dry tree stumps in many locations to deceive the enemy as to size and location of forces. Dummy gun positions can be constructed from materials at hand. Sound and flash simulators should be used in these positions to give them a semblance of reality. If dummy rubber vehicles and weapons are not available, snow and logs can be used as substitute materials. All deccptive measures must be well planned and carefully executed to give them every appearance of reality.

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24. General

a. (Superseded) Ground offensive operations are directed toward the destruction of the enemy in the least possible time. Actions will be sudden, violent, and decisive. An operation which is permitted to lag may result in a stalemate or may offer an opportunity for the enemy to seize the offensive. Both forces retain freedom of maneuver limited only by their ability to cope with the climatic and terrain conditions. Due to large operational areas, flanks and rear areas are usually lightly defended and present excellent opportunities for the conduct of unconventional warfare, for envelopment, or under favorable conditions, for turning movement.

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40. Raids and Rear Area Operations

a. General. (Superseded) In northern operations there are usually no continuous fronts. Units may operate independently many miles apart. Installations and communication centers are often isolated. Lines of communication, where they exist, are long and vulnerable to attack. Surprise is always a possibility, and security can only be guaranteed by accurate knowledge of enemy disposition, composition, movement, capabilities, and constant vigilance. The enemy is equally vulnerable. Conditions, both operational and environmental, facilitate raids on communications centers, headquarters, and installations of all types. Patrols, stay-behind forces, and special forces are well suited for these operations. Severe weather conditions enhance the effect of such operations.

44.1. Airmobile Operations

(Added)

a. Airmobile units, because of high mobility and organizational integrity (vehicles, supplies and equipment) enhance the possibility of success in northern operations. Airlanded elements with vehicles intact to carry the equipment necessary to live and fight, are capable of rapid deployment to the objective.

b. Assault type aircraft, to include Army aircraft equipped with skis, are capable of operating from relatively unimproved areas such as open fields, roads, or lakes and other water surfaces where the ice is of sufficient strength. During summer months, aircraft equipped with floats can use lakes and streams for landing areas. Consideration must be given to the reduction in payload capability of the aircraft because of the added weight of skis or floats and other survival equipment. In planning airmobile operations, every consideration should be given to multiple landing zones to give better dispersion of troops and reduce vulnerability to nuclear attack.

c. Helicopters, because of versatility and ability to takeoff and land in confined areas, are ideal air vehicles for airmobile operations. Helicopter capabilities and limitations must be noted. The variables of fuel, range and payload must be considered for trade-off, of one or the other when planning airmobile operations.

d. Additional information on airmobile operations is contained in FM 57–35.

44.2. Helicopter Rappel System

(Added)

Long range patrols, pathfinder personnel, demolition teams, etc., may be placed into inaccessible areas by means of the helicopter rappel system. However, this method of landing personnel should not be used except when the situation or the terrain makes it impossible to safely land the aircraft. For additional information concerning the rappel system consult FM 31–72 and USCONARC Training Circulars.

48. Airborne Operations

a. General. (Superseded) The mobility and flexibility characteristics of airborne forces are ideally suited for the diversified areas of the north. While conventional doctrine is as applicable to the north as elsewhere, some modifications to operating procedures are required to overcome the limitations imposed on airborne operations by the extreme environmental conditions. The guidance contained herein should be applied in conjunction with basic doctrine published in FM 57–10.

b. Factors Affecting Airborne Operations. (Superseded) Limitations that apply to airborne operations in temperate zones also apply in the north, and in many instances are amplified.

(1) The primary consideration is the capability of the troop carrier aircraft. Some of the limitations are:
   (*a*) The effect of weather (blizzards, ice fog, white-out).
   (*b*) Navigational difficulties caused by inadequate maps and charts and lack of natural landmarks and manmade structures.
   (*c*) The lack of adequate marshalling areas with warm shelters and suitable troop carrier bases.
   (*d*) The few hours of daylight for airlanded operations in winter.
   (*e*) The bulkiness of the clothing worn and equipment carried requires more aircraft space per individual. This necessitates an increase in the number of aircraft to transport and organization.
   (*f*) Maintenance difficulties resulting from insufficient maintenance shelters and decreased personnel efficiency.
   (*g*) Heavy snow or deep snow drifts on airfields and landing zones with associated snow removal problems.
   (*h*) Accumulation of frost, snow and ice on parked aircraft.
   (*i*) Difficulties in constructing landing strips in summer.
   (*j*) Uncertainty of radio communications.

c. Parachute Operations. (Superseded) The capability to deliver personnel by parachute is of particular importance in undeveloped areas where surface routes of communication are limited or nonexistent. Experience indicates certain operational and planning factors require special emphasis when airborne units are committed to parachuting in northern areas. In this connection, airborne commanders must familiarize themselves with the Arctic portion of TM 57–200.

(1) Airborne forces employed in northern areas must be capable of self-sustaining operations for 72 hours without benefit of resupply. In this regard, it is especially important that primary and contingency plans be made for linkup, resupply or exfiltration.

(2) The number of personnel that can be parachuted from a single aircraft is considerably reduced because of the bulk of equipment

and cold weather clothing used by paratroopers. For planning purposes the maximum number as listed in TM 57–220 should be reduced by one-third.

(3) The rigging of personnel and their equipment must be in a warm area. If this area is at a greater distance than 200 meters from the aircraft parking area, transportation is required.

(4) Winter equipped parachutists should load by way of the ramp of aircraft. To prevent possible accidents care must be taken to insure that the ramp is free of snow, ice, water, etc. This hazard is magnified on exiting the aircraft. Each aircraft should have equipment aboard to insure that the floor is as dry as possible prior to exiting over the DZ.

(5) Careful consideration must be given to the selection of DZ's. An open muskeg area that looks suitable on photographic and map inspection, will frequently prove to be covered with frozen hummocks of vegetation one-half to one meter in height. Much of the northern areas of the world are covered with scrub pine, ranging from one to ten meters in height. These areas with sparse tree growth make suitable DZ's. Additionally, every consideration should be given to the use of lakes and other water surfaces with sufficient ice depths as prospective DZ's.

(6) To avoid overheating personnel, aircraft cabin temperatures should not exceed 40° F. The heavy weight of the individual parachutist and his equipment will cause a more rapid descent than under temperate zone conditions. When the jump is to be made into a high altitude DZ, this rapidity of descent is magnified because of the thinness of the air.

(7) DZ assembly procedures and the use of assembly aids are especially critical in northern operations where considerable difficulties are encountered in assembling in tree covered areas deep snow, or during extended periods of darkness. Extensive training and rehearsals are required to overcome the problems of orientation after landing.

(8) If the DZ is snow covered, all parachutists should drop with snowshoes or skis attached. This technique will hasten DZ assembly time and will aid in speedy recovery of heavy drop items (TM 57–220).

(9) Special effort must be made to expedite and insure the recovery of equipment that is delivered by parachute. Daylight drops and the use of colored parachutes, streamers and smoke grenades are recommended; however, airborne commanders must designate personnel to spot dropped equipment and check for equipment aircraft aborts. The use of the Army Assault Team (AAT) or pathfinders in this role has proven to be practical.

(10) Tent group equipment should accompany airborne units on the initial drop. This equipment should include the tent, 5 or 10-man, Yukon Stove, fuel and rations. The tent group equipment should be packed on the sled, 200 lb, boat-type. These sleds should then be heavy dropped on load bearing platforms. The number of sleds to be loadcd on one platform will depend on type of aircraft and available type of platforms. Ideally, the sleds should not be loaded in less than platoon groups.

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Section X. Special Forces and Psychological Operations (Added)

49.1. Special Forces

a. The role of special forces is to develop, organize, equip, train, and direct indigenous forces in the conduct of guerrilla warfare, related unconventional warfare activities, and to participate in counterinsurgency operations (FM 31–20 and FM 31–21).

b. Special forces operational detachments are tailored to provide training in basic functions of command, staff operations, intelligence, weapons, tactics, communications, medical, and demolitions. Individuals skilled in a primary MOS are cross-trained in one or more of the remaining specialties. These individuals are also trained in mountaineering, cold weather, snow, and northern operations techniques. They are trained to live in the harsh environment of the north and to train remote groups to best use their native ability in the conduct of guerrilla or counterguerrilla warfare.

49.2. Psychological Operations

The extremes of weather, terrain, and climate encountered in northern operations presents commanders with unusual problems. Every effort must be made to condition and prepare troops mentally, as well as physically, prior to commitment in this hostile environment. PSYOP officers, utilizing their background and training, may assist unit commanders and others in preparing informational material and troop topics designed to alleviate unnecessary fear, stress survival techniques, and, in general increase the fighting potential of the soldier. PSYOP unit capabilities may be used to produce literature, handouts, posters, and broadcasts to reinforce or supplement troop and command information (FM 33–5).

49.3. Enemy Target Audiences

The decentralized and dispersed nature of northern operations will present additional psychological vulnerabilities among enemy forces. The following target audiences are examples:

a. Isolated units removed from the main stream of activity for prolonged periods.

b. Small unit leaders operating with unaccustomed freedom and independence beyond the control of immediate political and military superiors.

c. Front line units that have too long endured the rigors of cold northern life.

d. Civilian inhabitants who have been forced to surrender already scarce fuel, food, or shelter to the enemy.

49.4. Themes

Examples of themes that are effective in northern operations in attacking hostile target audiences are those that stress—

a. Solitude, privation, and monotony.

b. Dearth of equipment and comfort items versus United States abundance.

c. Personal dangers such as frost bite, loss of limb, cold injuries, and disease.

49.5. Media

Media considerations peculiar to the arctic environment include—

a. "Blackouts" from the auroral effect or atmospheric static must be considered when planning and programming PSYOP radio broadcasts. Antenna erection in frozen ground and the effect of extreme cold on batteries are significant factors. See section II, Radio Communications.

b. Snowstorms, muddy ground, and high winds are detrimental to leaflet operations. Ground immobility, static winter quarters, and limited road networks are assets.

c. Planning for the use of loudspeakers should consider man portable devices, the application of existing vehicular-mounted loudspeakers to modes of transportation commonly found in the area of operations, and rotary wing or fixed wing aircraft.

55. Mobility Planning

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d. (Superseded) Army aviation is employed to supplement ground transport and is used freely when such use results in net economy in effort (fig. 15). For example, the use of helicopters to deliver daily ration issues to forward rifle companies frequently effects a major saving in effort for the battalion. The use of helicopters to return empty rolling liquid transporters materially reduces turnaround time and increases the effective availability of the transporters.

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58. General

a. Organization.

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(2) (Superseded) When brigade or smaller task forces are employed independently, general support is provided on an area basis and direct support is provided by an independent support battalion

or mobile direct support elements tailored to fit the size of the force.

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60. Direct Support

(Superseded)

a. Direct support to the brigade is normally provided by division support command elements in the brigade trains area. These elements are selected supply, medical, and maintenance elements of the division support command charged with providing logistical support to the brigades and to other divisional units. These units are provided for support to each committed brigade and for area support and division units operating in the brigade area.

b. The division support command elements in the brigade trains area normally consists of the following:

(1) A forward support company of the maintenance battalion with teams from the aircraft maintenance company.

(2) A medical company from the division medical battalion. This company normally establishes and operates a clearing station and also provides medical evacuation from the combat battalion aid stations and provides for the medical supply requirements of the brigade.

(3) A forward supply section of the supply and service company. This section operates one distribution point for class III supplies and one for class I, II, and IV (except medical).

c. The division support command elements normally operate under the control of the support command commander. However, when the brigade is organized for independent or semi-independent operations, the direct support elements are normally attached to the brigade.

d. For additional information on the organization and operation of the division support command, see FM 54–2.

e. Direct support to separate independent brigades is normally provided by an attached or assigned support battalion. This battalion contains all the direct support elements necessary to support the brigade in independent operations, and closely parallel the elements provided by the division support command to divisional brigades.

64. Storage

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c. (Superseded) Mobile direct support stocks, including class V, are held on mobile storage vehicles. Stocks, including spare parts, may be transported in CONEX containers, which afford good environmental protection. Class I and class V stocks are unitized on pallets and the mobile direct support element is provided with tracked fork-lifts to facilitate handling of unitized and containerized supplies. Mobile direct support class III stocks are held in rolling liquid transporters and flexible

tankage in so far as possible. POL may also be stored and distributed in 600-gallon skid-mounted tanks equipped with powered or hand pumps. Drums are used only when more efficient methods are not available. Resupply movements of heavy tonnage commodities are managed between the general support and direct support activities so as to take maximum advantage of in-transit loads for backup stocks instead of tying up transport and supplies in static on-vehicle loads at the direct support element.

65. Distribution

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c. (Superseded) The distribution system utilizes all available means of transport for essential movements. Loads are consolidated for forward movement. Loaded vehicles are routed through to the farthest forward breakdown point. As far as practical, loaded vehicles and containers are exchanged for empties at the point of use and empties are moved to the rear by the earliest available transport. Prompt return of empty containers, with particular emphasis on rolling liquid transporters, is essential to prevent interruption of the distribution operation; a continuing forward flow of containers, without effective return of empties, must soon exhaust resupply capabilities. When part of the MSR utilizes roads on which wheeled vehicles are employed, rendezvous points are established for transfer of loads from wheeled to tracked transport. To reduce labor at the transfer point and throughout the distribution system, supplies are palletized or containerized and held in unitized packages as far forward as possible. Cross-country materials handling equipment (MHE) capable of handling unitized loads is provided to the task force. Emergency resupply deliveries to the task force and medical evacuation from direct support element clearing stations is accomplished by Army aircraft controlled by the general support organization. All transport capabilities are centrally coordinated within the general support organization and the independent task force.

68. Evacuation

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c. (Superseded) The most practical means of patient evacuation is by helicopter. Ideally, the task force surgeon should be furnished helicopters for primary evacuation. For evacuation outside of the task force area, air evacuation out of the theater is again the primary means. Aircraft, resupplying the task force can be used to carry patients on the return trip.

76. Prisoners of War

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b. (Superseded) In order to allow for timely interrogation of prisoners of war, there is a necessity for prompt evacuation, to include utilization of aircraft, in order that this source of intelligence information can be fully

exploited. If air evacuation is utilized, security of prisoners of war must be extremely strict while in flight.

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114. Toxic Chemical Agents

a. Production of Casualties.

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(2) (Superseded) For a toxic chemical agent to produce a casualty through the respiratory system, the agent must be capable of being vaporized or converted to aerosol. While the freezing point of a toxic chemical agent is not an exact indicator of its volatility, generally, the lower the temperature, the more difficult it becomes to vaporize or aerosolize a given toxic chemical agent.

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c. Defensive Measures. Problems of individual * * * are listed below.

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(5) (Superseded) The multilayer clothing normally worn in freezing weather offers fairly good protection against skin absorption of frozen persistent effect chemical agents. However, there is a great danger to personnel wearing contaminated clothing in a heated shelter. The heat will volatilize the chemical agents and can thus produce casualties.

117. Flame Operations

a. (Superseded) Flame operations can be utilized to advantage in both offensive and defensive operations in the northern latitudes. The standard portable and mechanized flame throwers have the same limitations as other mechanical type weapons containing moving parts and rubber components when operated at low temperatures. Both weapons must be winterized as prescribed in FM 31-70, TM 3-376, TM 3-1040-204-12, TM 3-1040-211-12, TM 3-1040-206-10, and TM 3-1040-209-12 before they will perform satisfactorily. In addition to winterizing the weapons, special procedures must be followed in preparing thickened fuels used by these weapons to insure that the fuels will gel. These procedures involve either heating the fuel ingredients or, if this is impractical, using a chemical additive called a peptizer. Thickened fuels should not be stored for extended periods of time, since they tend to deteriorate after 48 hours and may not work satisfactorily.

b. (Superseded) At low temperatures, the ignition of flame thrower fuels may not occur readily. To insure ignition, two or more charges from the ignition cylinder should be ignited before firing a burst. SOP for the employment of flame weapons should provide that sample batches

of thickened fuels be prepared and the weapons be test-fired under conditions approximating those expected to be encountered at the time of employment (TM 3-366 and TM 3-376, TM 3-1040-204-12, TM 3-1040-211-12, TM 3-1040-206-10 and TM 3-1040-209-12).

c. (Superseded) Flame expedients (FM 20-33) involving the use of thickened and unthickened fuels do not suffer from the same limitations as do mechanical flame throwers. These weapons, if properly fabricated and emplaced, will perform satisfactorily under all conditions of temperature. Since ignition at low temperatures is more difficult, additional ignition charges in the form of incendiaries should be incorporated in flame expedients.

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124. Field Fortifications

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b. Excavation is difficult in frozen ground. In frozen ground, hand tools are of little use. Explosives are effective when properly used, but large quantities are required. Charge calculations cannot be made directly from data in FM 5-25 because of variations in moisture content, soil types, and vegetable content as well as property changes resulting from low temperatures. Consequently, demolitions must be computed on an experience factor basis. Test shots will be necessary in most instances. An expedient, although slow, method is to build a fire on the ground and dig out the soil as it thaws. Too much thawing of large areas, however, makes digging difficult unless there is adequate drainage. Gravel is easier to excavate because it does not freeze as solidly as silt or clay and has better drainage. Natural soil deposits that have been excavated should be mixed with water, backfilled as fortification and tamped in place. Use of available materials should be encouraged to the maximum extent to decrease logistical requirements.

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125. Roads and Trails

a. (Superseded) Routes of communication existing in most northern areas are generally limited to an extremely primitive road and trail network, thus necessitating a major construction effort to assure movement and resupply. Full utilization of all intelligence available through map, ground, and aerial reconnaissance is mandatory to assure proper route selection and avoid needless dissipation of construction effort. Route selection criteria vary by season; summer routes being selected for ground bearing (in most instances areas with deciduous trees offer best trafficability), whereas grades generally dictate winter routes because of the difficulties encountered in earth moving during subzero weather. Tracked vehicles do not eliminate the need for roads, regardless of the season.

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e. (Superseded) The construction of snow roads for wheeled and tracked vehicles and snow removal or compaction on all types of roads and trails is important. Normally, snow is removed by snow plows, graders, angledozers, and drags. Early winter snow clearance accelerates the penetration of frost into any unstable subgrade, consolidating the subgrade. The snow removed from the road is scattered away from road ditches. Piling of snow or forming of snow banks along the road creates a condition favorable to the deposit of snowdrifts. Deep-rutted snow which is hardened by traffic or freezing can be leveled with harrows, drags, graders, dozers, or by packing loose snow into ruts. Road surfaces, culverts, bridge channels, and ditches are maintained and kept clear to provide melted snow drainage. Maintenance of roads made by combat troops for tracked vehicles normally consists of such tasks as straightening sharp curves, filling holes, building turnouts, and draining surface water. Frequently, winter traffic effects on snow roads will result in a loose snow-soil mixture which cannot be compacted. If temperatures are sufficiently low, this condition can be corrected by adding water and restoring stability by freezing. In the more common case, traction can only be restored by removing the unstable material.

126. Ice Routes

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c. Points for consideration during reconnaissance:

(1) (Superseded) Immediately adjacent to the shore, the ice formation is thin and weak and more likely to develop cracks than in the center of the frozen stream. However, depending upon the gradient of the river bed and thickness of the ice near the shore, it is generally safer to maintain a route near either shore when the ice rests upon the bed of the river and is sufficiently thick to support the intended load.

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(4) (Superseded) Good quality ice is characterized by being clear and free from air bubbles and cracks. In a body of water containing both clear and cloudy ice, both types should be checked for thickness because the clear ice will frequently be thinner than the cloudy.

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(6) (Superseded) Flooded snow when frozen produces what is called "slush ice". This ice is characterized by being white and may contain both large and small air bubbles. As a general rule, the carrying capacity of this ice should be rated at ¼ less than that of prime natural ice.

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(10) (Superseded) In spring, the main body of ice can be traveled over if water is on the surface for a limited time only. Caution should be used, especially when pot holes are present.

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e. (Superseded) Ice which appears cloudy or milky should be closely inspected for thickness and air pockets. The cloudy or milky condition is caused by gas or air being trapped within the ice. This type of ice may form over a lake or swamp (muskeg), which has decaying vegetation on its bottom. When testing the thickness of ice, it should be determined whether the water level beneath the ice has dropped. If the ice is no longer supported by the water, it may be too weak to support heavy loads. This condition is likely to occur in shallow streams. Ice over running water should be carefully tested to discover whether the current has eroded the underside of the ice. This is especially necessary where there is snow cover.

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g. (Superseded) Ice deforms under a continuing load. After a load passes over it, the ice recovers, almost to its original shape. If a load is allowed to stand still on the ice, the ice surface will depress and may reach the danger point. This "load" is then the critical weight for the strength of the ice at a particular location or in a particular condition. During the thaw period the ice becomes dull and weak and will quickly lose its load-bearing capacity. Open wet cracks transverse or parallel to the roadway can be dangerous. These cracks indicate that the roadway should be relocated. A dry crack can be repaired by filling with water.

h. (Superseded) Preparation of river ice for traffic may be facilitated by flooding the existing snow layer. The snow layer should be compacted before flooding and the compacted area should be three or four times as wide as the intended roadway. This can be done by driving a light track-laying vehicle over the snow or by a squad of men on snowshoes. A corduroyed section can be used as a filler material but should be placed so that it will not be exposed above the final roadway surface. Removing the insulating snow layer is another way to increase the ice thickness; however, this is a much slower process than flooding, and should only be used when flooding is impossible.

i. (Superseded) The strength of ice varies with its structure and temperature. A snow cover or a warm current will affect the ice temperature and generally will produce a thinner and weaker ice cover. Table II provides working capacity figures for ice of varying thicknesses.

Table II. Load Bearing Capacity of Fresh-Water Ice (Superseded).

Load	Ice measurements in centimeters for temperatures 0 to 10 F.		Distance in meters between units
	Risk*	Normal	
Single soldier on skis	4	5	5
File of soldiers—2 pace intervals	8	10	
Vehicles:			
¼ ton truck	13	20	15
¾ ton truck	17	25	20
2½ ton truck	33	40	25
5 ton truck	45	55	60
5 ton tractor w/loaded trailer	80	90	80
XM561 Cargo Carrier	20	25	20
M8A2 tractor	45	65	70
M41A1 Tank	45	65	60
M48A2 Tank	67	80	70
M60 Tank	67	80	70
M88 Tank Recovery Vehicle	71	85	70
M108 Howitzer, SP 105mm	45	50	40
M109 Howitzer, SP 155mm	45	50	40
M110 Howitzer, SP, 8"	50	55	50
M113 APC	33	45	25
M114 Armored Carrier (C&R)	26	40	20
M116 Cargo Carrier	19	35	15
XM578 Recovery Vehicle	50	65	60
Tractor D7	45	50	40
Tractor D8	50	60	50
Crane 20 ton	50	60	70
Grader	35	40	50
M6 Transporter, Rolling Liquid	20	25	N/A
			Distance in meters between aircraft
Aircraft:			
O-1A, E	13	20	10
OV-1A, B, C	24	45	20
U-1A	20	25	20
U-6A	17	25	15
U-8D, F	17	25	20
CV-2A	36	50	55
CV-7A	42	50	60
OH-13H	11	18	10
OH-23D	15	18	10
UH-1A, B, D	20	25	20
UH-19D	19	30	20
CH-21C	27	35	25
CH-34C	25	33	25
CH-37B	38	50	60
CH-47A	39	50	60

* Risk ice measurements can be used for individual crossings with safety. The normal ice measurements are for repeated loadings.

Note. Vehicles should maintain speeds of approximately 16 km per hour—for water from 3 meters to 6 meters deep, and 32 km per hour for deeper water. Distances in meters between aircraft have been computed based on maximum allowable gross weight and may be adjusted based on loads carried in individual aircraft.

* * * * * * *

l. (Superseded) The simplest method of reinforcing ice is to flood the existing ice surface. If a snow layer is present, do not remove it but rather compact and flood it. Flooding should not be confined to an area between snow banks. Free flooding is more desirable in that it requires less effort and generally produces a better load-carrying bridge. If branches or small poles are available, they can be laid on the existing surface before flooding. The final surface should not have any of the branches or poles exposed. Their dark color will absorb radiation and cause melting.

Figure 22. Corduroy road over frozen river. **Rescinded.**

Table III. Reinforcement of Fresh-Water Ice. **Rescinded.**

m. (Superseded) Maintenance of ice crossings is mandatory and includes reinforcement, snow clearance or compaction, approach road maintenance, and surface repair and improvement of wearing surface. Snow clearance or compaction is carried out to make the crossing trafficable to vehicles and to influence the freezing or thawing of the surface. Approach road maintenance is the same as that required for bridge and ford approaches. Badly worn or rutted surfaces are repaired by blading and filling or by re-covering the surface with snow and packing and freezing. Ice crossing lanes should be separated by 45 to 60 meters.

* * * * * * *

127. Airfields

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b. (Superseded) Deep soft snow presents difficulties in the landing and takeoff of airplanes, even when they are equipped with skis. The deeper a ski sinks into the snow, the longer will be the ground run required for takeoff. Repeated pulverizations each followed by light compaction and backfill will densify the supporting snow structure for aircraft traffic.

c. Preparation of Landing Sites for Helicopters.

* * * * * * *

(7) (Added) It may be advantageous at times to use portable airfield surfacing materials such as prefabricated steel or aluminum mats or membrane surfaces. However, this material will not normally be available and its use may create problems in handling during extreme low temperatures. It is more economical to use the abundant snow and ice in all cases of temporary heliport or airfield construction than to transport the portable mats.

128. Camouflage

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c. (Superseded) Issue camouflage nets, wire mesh, and garnishing materials used for camouflage on snow covered terrain should be whitewashed or painted with white paint to improve their effectiveness. Vehicles, aircraft, artillery pieces and tanks should be painted white to blend with their surroundings. Camouflage painting is generally best accomplished by painting the entire vehicle with an extremely light coat of white so that a trace of basic color shows through to form varying shades of gray. Pattern painting is then applied to this. Special care must be given to tracks and wheels since, as a general rule, painting will not prove satisfactory because of wear. Vehicle crews must be trained, upon halting, to pile snow around tracks and wheels. Deceptive track plans in snow are essential. Tent camouflage can be accomplished by scattering snow on the tent after it is erected.

131. Problems for Engineers and Commanders

* * * * * * *

b. (Superseded) Existing engineer organizations can be adapted without difficulty to northern conditions, however, modifications will usually be required in the type and nature of their equipment. In general, the amount of engineer heavy construction equipment must be increased with crawlers replacing wheeled tractors; tracked personnel and cargo carriers must be added to permit equal mobility of supported and supporting units; and special purpose equipment (ice augers, Herman Nelson or Hunter heaters, and extra maintenance shelter) added to compensate for the environmental conditions. This in turn will necessitate some revision of specialist requirements. Such modifications and the overall requirement for engineer units, however, vary much more widely in the north than in other regions with the season, the operational theater, and the mission of the force. During the planning stages, all these factors must receive detailed study to determine the proportion of engineers in the task force, the type of equipment needed, and the organization they require.

c. Environmental characteristics of the Far North which complicate engineer tasks are—

* * * * * * *

(6) (Added) Terrain such as mountainous, muskeg or tundra regions.

d. Specific engineer tasks complicated by northern conditions are—

* * * * * * *

(10) (Added) Construction of troop shelters and administrative facilities.

* * * * * * *

133. General

a. The operation of * * * the following exceptions:

(1) (Superseded) Medical units which are intended to be highly mobile should use the Tent, GP, Small, in preference to the larger and heavier general purpose tents.

* * * * * * *

Section XIII. CHAPLAIN (Added)

146.1. General

(Added)

a. The chaplain in northern operations can perform his duties in sub-zero temperatures in much the same manner as he can in any other climate; however, these duties will be affected by the extremes of the environment.

b. The wheeled vehicle normally assigned to the chaplain lacks the necessary cross-country mobility, therefore he must be provided alternate means of transportation, i.e., a tracked vehicle, helicopter, etc. The chaplain will sometimes lack adequate space for counseling and may find communication difficult with other elements when supported units are operating during adverse weather and at extreme distances.

c. Because of the possibility of frostbite, caution must be exercised when conducting services in the open during periods of extreme cold.

146.2. Religious Services

(Added)

a. During periods of extreme cold and because of the lack of heated shelter, chaplains may not be able to conduct certain types of services.

b. High winds and cold may eliminate the possibility of setting up an altar with ecclesiastical appointments thereby making it necessary to streamline the worship service wherever possible.

c. Chaplains whose congregations are under obligation to attend religious services on the Sabbath or Sunday may find it necessary to utilize privileges excusing troops from mandatory attendance.

d. It may be necessary for the chaplain to adjust vestments to be worn over his field uniform and the troops permitted to continue to wear headgear and other protective clothing throughout the service.

e. Care must be taken in handling metal objects used in the worship service. Chalices and cups may freeze to the mouth or hands. Water and sacramental wine may freeze in these objects if they are not already frozen before pouring. If it is an integral part of the service, it will be necessary to take proper action to keep wine warm enough to be poured.

f. Every effort should be made to conduct services for small groups in heated shelters.

148. General Effect of the Environment on Communications

a. (Superseded) Very low frequency radio communication is reliable in the northern latitudes of the world. High frequency transmission and reception, while capable of spanning the extended distances dictated by tactical requirements, are subject to interference by magnetic storms, aurora borealis, and ionospheric disturbances, which may completely black out reception for hours, or even days. Transmission and reception on frequencies in the very high frequency and higher bands is reliable under most conditions providing proper installation and operation procedures are followed. Single Side Band (SSB) radios will provide an improved method of radio communications, since atmospheric conditions cause less interference to SSB transmissions.

* * * * * * *

150. Propagation Methods

a. (Superseded) Radio communications in the northern latitudes offers no exceptional propagation difficulties if sufficient emphasis is placed on the selection and use of proper frequencies and if the radio propagation graphs, charts, and prediction data presently available are fully utilized.

* * * * * * *

e. (Superseded) Tactical radio equipment operating in the so-called line-of-sight frequency band (30 mc and upwards—the frequency modulated series of tactical radio sets are included in this band) is not affected adversely by auroral activity. In fact, the greater ionization of the upper atmosphere which takes place during aurorals will, on occasion, increase the range of the tactical FM radios. The use of VHF and Microwave Radio Relay equipment will provide the greatest degree of reliability for multi-channel means of communication, and should be considered as the primary means of communications in northern areas. Tactical tropospheric scatter radio equipment, when available, is another reliable means of providing multi-channel communications for distances up to approximately 300 kilometers.

156. Techniques and Expedients for Increasing Range Reliability of Radios

a. Where radio communication * * * at all times:

* * * * * * *

(4) Preventive maintenance procedures * * * the following points:

* * * * * * *

(*j*) (Added) Additional guying for antenna masts is required to prevent mast failure caused by severe cold and extremely high winds.

(*k*) (Added) Insure that the proper antenna length is used relative to operating frequency.

(*l*) (Added) Check to assure that the antenna has been erected properly and as high as possible.

* * * * * * *

c. The following techniques * * * of radio circuits:

* * * * * * *

(5) (Added) Use Army aircraft for FM radio retransmission or relay when out of normal range, or other means or retransmission as practicable. Either intermediate voice or automatic retransmission from the aircraft can be employed in many situations. This will often prove to be the only means of successful communication to isolated teams and units, and for long-range patrols.

157. Radio Communications

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c. (Added) The use of low or medium channel-capacity VHF/UHF radio relay equipment mounted on small tracked vehicles will provide the most reliable means of communications to mobile task forces as low as battalion size organizations. Such equipment configurations should retain the same mobility and concealment requirements as the supported unit while providing reliable telephone communications not subject to northern propagation difficulties.

d. (Added) The use of the Radio/Wire Integration technique to extend both radio and wire circuits will be an important factor in successful communications.

158. Factors Affecting Wire Communication

(Superseded)

Tactical wire communication has the same capabilities and limitations in northern latitudes as in temperate zones. Due to the distances involved and the difficulty of overland movement, wire communications may be limited to telephones serving local installations. If long distance wire communications trunks (telephone, teletype, facsimile, and data transmission) are required, radio relay systems which can be integrated into the wire system must be considered because of relative ease of installation, economy of transport, and other logistic factors. The installation of radio relay systems on mountain tops will normally be necessary for extension of long distance wire circuits. Extensive planning for installation, maintenance, and support of equipment and support and survival of personnel operating these mountain-top relay sites is mandatory. Consideration must be given to the fact that more time is required to install and maintain field wire lines during periods of extreme cold and deep snow. Batteries which are used to operate field telephones and switchboards are subject to the same temperature limitations as those used to power the small portable tactical radio sets.

166. Aircraft Messenger Service

(Superseded)

Messenger service should be scheduled between units and should, if possible, be integrated with the aerial resupply missions. The use of helicopters for messenger service must be considered, as units will seldom be located near landing areas suitable for fixed wing aircraft.

167. Vehicular Messenger Service

* * * * * * *

b. (Superseded) It is essential that all vehicles utilized for messenger service over infrequently used routes possess the capability of over-snow operation, and be equipped with radio, emergency equipment, snowshoes, heating apparatus, and simple navigational equipment. It is likewise essential that messengers be trained in radio operation and ground navigation. When security permits, the vehicle should be kept in continuous communication with its headquarters. The unit to which the vehicle is destined should be informed by enciphered radio message as to the time of departure and expected time of arrival.

174. Radio Receivers and Transmitters

(Superseded)

Upon exposure to extreme cold, radio receivers and transmitters adjusted for operation in a relatively warm place may exhibit, in their frequency determining circuits, changes of sufficient magnitude to impair their operation. Low battery voltage will also have a detrimental effect on frequency determining circuits. All radio operators must be trained to make frequent checks for proper frequency. It is particularly important that the operators at the radio net control stations be alert to this condition and that they require the secondary stations of the net to make necessary adjustments to keep them on frequency.

193. Supervision

a. (Superseded) At the beginning of training, instruct troops in the "Buddy" system for detecting frostbite, under which each man periodically inspects the face and hands of his neighbor. In spite of this, it is necessary, particularly during the early stages of training, for instructors to check troops frequently for frostbite, frozen feet or hands, and overheating. It is extremely important that all personnel thoroughly understand the meaning and effects of windchill and how to cope with it. For an explanation of windchill and its contributing factors see change 1 to FM 31–70.

* * * * * * *

Figure 24. Windchill nomograph. **Rescinded.**

APPENDIX I
REFERENCES

(Added in proper numerical sequence)

FM 3–5	Chemical, Biological, and Radiological (CBR) Operations.
FM 3–10	Chemical and Biological Weapons Employment.
FM 3–12	Operational Aspects of Radiological Defense.
FM 17–36	Divisional Armored and Air Cavalry Units.
FM 20–15	Pole and Frame Supported Tents.
FM 20–16	Air-Supported Tentage.
FM 20–33	Combat Flame Operations.
FM 21–40	Small Unit Procedures in Chemical, Biological, and Radiological (CBR) Operations.
FM 21–41	Soldiers Handbook for Chemical and Biological Operations and Nuclear Warfare.
FM 21–48	Chemical, Biological, and Nuclear Training Exercises and Integrated Training.
FM 21–50	Ranger Training and Ranger Operations.
FM 21–75	Combat Training of the Individual Soldier and Patrolling.
FM 21–76	Survival.
FM 21–77	Evasion and Escape.
FM 31–16	Counterguerrilla Operations.
(C)FM 31–20	Special Forces Operational Techniques (U).
FM 31–21	Guerrilla Warfare and Special Forces Operations.
FM 31–22	U.S. Army Counterinsurgency Forces.
FM 33–5	Psychological Operations.
FM 57–10	Army Forces in Joint Airborne Operations.
FM 101–40	Armed Forces Doctrine for Chemical and Biological Weapons Employment and Defense.
TM 3–210	Fallout Prediction.
TM 3–220	Chemical, Biological, and Radiological (CBR) Decontamination.
TM 3–4240–202–15	Operator, Organizational, Field, and Depot Maintenance Manual: Mask, Protective, Field, M17.
TM 3–1040–204–series	Flamethrower, Portable, M2A2–7.
TM 3–1040–206–series	Flamethrower, Mechanized, Main Armament, Turret Mounted, M7A1–6.
TM 3–1040–209–series	Flamethrower, Mechanized, Main Armament, M10–8.
TM 3–1040–211–series	Flamethrower, Portable, ABC–M9–7.
TM 57–220	Technical Training of Parachutists.

APPENDIX III

COMMANDERS' GUIDE LINES FOR NORTHERN OPERATIONS

1. Leadership

* * * * * * *

e. (Added) Planning is one of the most essential elements for the successful conduct of northern operations. Planning time can be shortened by the use of SOP's. A workable, simple, well-rehearsed SOP is mandatory for all units down to include platoon level.

f. (Added) Most of the disabling problems associated with winter operations in northern areas can be avoided if commanders at all echelons are knowledgeable concerning the individual soldiers response to stress and fatigue.

g. (Added) Health is of primary importance. Without dynamic personal leadership the average soldier in northern operations becomes lethargic, dehydrated and undernourished with resultant mental and physical degeneration. To prevent this, commanders must insure that personnel consume adequate water and nourishment, and practice good personal hygiene habits.

4. Artillery and Fire Support

a. (Superseded) Close and continuous personal contact between the brigade commander and the artillery commander is essential to permit displacement with minimum instructions and to insure continuous fire support.

* * * * * * *

GLOSSARY

(Added in proper alphabetical sequence)

Blizzard—A long severe snowstorm or an intensely strong cold wind filled with drifting fine snow (ground blizzard).

Crevasse—A fissure or rift in glaciers, shelf ice, or other land-ice formations, caused by thermal changes in the ice or by motion of the ice or by motion of the ice over underlying obstacles.

Glacier—Any field or stream of ice of land origin. It may be either active or stagnant.

Icecrete—A mixture of sand, gravel and water, frozen and used as a concrete substitute.

Ice Field—A stagnant glacier.

Permafrost—Permanently frozen ground. A thickness of soil or other surficial deposit or even a bedrock at a variable depth beneath the surface of the earth in which a temperature below freezing has existed continuously for thousands of years.

Skijoring—Troops mounted on skis and towed behind vehicles.

Slough—Part of the natural drainage system for either an area or a stream. Water will sometimes back up into this area leaving ponds and temporary streams. Generally the surface will be muddy and covered with vegetation of all types.

Whiteout—A condition of visibility which exists when an overcast sky prevents shadows, and snow covered terrain reflects light at about the same intensity as the sky causing the horizon to be undistinguishable and the recognition of irregularities in terrain very difficult. Only dark objects can be seen. Fog, ice fog, and blizzard conditions will sometimes create a similar situation.

Windchill—The combined cooling effect of wind and air temperature on heated bodies.

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NG: State AG (3); Units—same as active Army except allowance is one copy to each unit.

USAR: None.

For explanation of abbreviations used, see AR 320–50.

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